

Fitch - Homoptera -

W813

With respects of
Abbie M. Fitch Andrews,

J. H. Comstock

(C.)

CATALOGUE

WITH REFERENCES AND DESCRIPTIONS

OF THE

I N S E C T S

COLLECTED AND ARRANGED FOR THE

State Cabinet of Natural History,

BY ASA FITCH, M.D.

The following paper comprises all the New-York *Insects of the sub-order Homoptera* known to me, except some of the minute species, to determine which required further researches. The species and genera that are here presented as new, are indicated by an asterisk preceding the scientific name, and a brief description of these, embracing their essential characters, is added. To the described species is appended a reference to the name of the author and the place where the original description will be found.

In the generic arrangement of these insects, Amyot and Serville's *Hist. Nat. des Ins. Hemipteres*, Paris, 1843, and Westwood's Synopsis of British Genera, have been my chief guides. An acknowledgment is due to the Rev. D. Zeigler, of York, Pa., for a copy of Germar's paper on the genera Clastoptera, &c., in the *Zeitschrift f. d. Entom.*; and to Dr. T. W. Harris, of Harvard University, who has been so kind as to place temporarily in my hands his entire collection of Homoptera, including the several species named in his Catalogue, and also those magazines and other publications which contain all the more important papers of Germar, Spinola and Fallen upon this order of insects. I regret that these latter favors were not received in season for me to avail myself of them in preparing the following paper, though it is not probable they would vary it in any important point from the shape in which it is here presented.

Albany, February 22d, 1851.

INSECTS.

FAMILY CICADIDÆ.

CICADA. LINN.

FROSTED CICADA, *C. pruinosa*, (Say.) Jour. Acad. Nat. Sci., vol. iv., p. 330. The specimen was taken near the east end of Long Island. No. 609, male.

DOG-DAY CICADA, *C. canicularis*, (Harris.) Inj. Ins., p. 175. No. 610, male; 611, female.

CREVICED CICADA, *C. rimosa*, (Say.) Jour. Acad. Nat. Sci., vi. 235. Two specimens were taken in Washington county the middle of June, 1845. As these are the only ones I have ever met with, I am led to suspect that, like the following, this species may be periodical in the time of its appearance. No. 612, female.

SEVENTEEN-YEAR LOCUST, *C. septendecim*, (Linn.) Syst. Nat., ii. 708. No. 613, male.

FAMILY FULGORIDÆ.

CIXIUS. LAT.

STIGMA-SPOTTED CIXIUS, *C. stigmatus*, (Say.) Jour. Acad. Nat. Sci., iv. 336. On various trees and shrubs. No. 614, male; 615, female.

PINE CIXIUS, **C. pini*. Elytra with a few fulvous, cloud-like spots; destitute of a larger black stigma and black band at the base. Length to the tip of the elytra, 0·23, (twenty-three hundredths of an inch.) Found on spruce, fir, and pine. Smaller than the preceding, and evidently distinct. No. 616, male; 617, female.

IMPUNCTATE CIXIUS, **C. impunctatus*. White, dorsum yellow; two bands on the front, two dots on the vertex, and two on the prothorax, black; elytra brownish-pellucid, immaculate, nerves impunctate. Length, 0·23. Found on oaks. No. 618, male.

Var. *a*. The whole upper half of the face black. No. 619, male.

FIVE-LINED CIXIUS, *C. quinquelineatus*, (Say.) Jour. Acad. Nat. Sci., vi. 241. No. 620, female.

DELPHAX. FAB.

FIELD DELPHAX, **D. arvensis*. Pallid-yellow, immaculate; elytra and wings pellucid. Length 0·17. Common in fields of wheat early in June. No. 622, male; 623, female.

DORSAL-STRIPED DELPHAX, **D. dorsalis*. Dull yellow, dorsal vitta white; elytra dusky, middle apical nerve and a small dot on the tips of the outer apical nerves black; facial carinæ white, interstices black; tergum black, with a dorsal and lateral vitta orange red; legs pale yellow, striate with black. Length, 0·20. No. 621, male.

OTIOCERUS. KIRBY.

DEGEER'S OTIOCERUS, *O. degeerii*, (Kirby.) Trans. Linn. Soc., xiii. 16. On various trees. No. 624, male; 625, female.

COQUEBERT'S OTIOCERUS, *O. coquebertii*, (Kirby.) Tr. Linn. Soc. xiii. 18. Sometimes abundant on grape vines; also on beech and oak trees. No. 626, male; 627, female.

Var. *a*. The elytral vitta dividing into three branches. No. 628.

b. The vitta not prolonged upon the sides of the thorax. No. 629.

WOLF'S OTIOCERUS, *O. wolffi*, (Kirby.) Tr. Linn. Soc., xiii. 19. Taken on walnut bushes. No. 630, male.

ABBOT'S OTIOCERUS, *O. abbotii*, (Kirby.) Tr. Linn. Soc., xiii. 17. Taken on oaks. No. 631, male; 632, female.

KIRBY'S OTIOCERUS, **O. kirbyii*. White; elytra without dots, with a faint brownish band from the middle of the inner to the apex of the outer margin, and spot on the apex of the inner margin. Length, 0·42, to the tip of the elytra. Found on oaks. No. 633, male; 634, female.

ANOTIA. KIRBY.

BONNET'S ANOTIA, *A. bonnetii*, (Kirby.) Tr. Linn. Soc., xiii. 21.
On willows, about the middle of September. No. 635,
male; 636, female.

PÆCIOPTERA. LAT.

FROSTED PÆCIOPTERA, *P. pruinosa*, (Say.) Jour. Acad. Nat.
Sci., vi. 237. No. 637, male; 638, female.

COMMON PÆCIOPTERA, **P. (?) vulgaris*. Blackish-pruinose; elytra with a transverse row of pellucid-white points beyond the middle; legs pallid, femurs blackish; ventral segments edged with orange; medial carina sometimes obsolete. Seems more allied to this than any other genus, though the simple neuration of its elytra, and some other marks, present discrepancies to this association. Length, 0.20. Common on various shrubs and trees. No. 639, male; 640, female.

FAMILY MEMBRACIDÆ.

ENCHOPHYLLUM. AMY. and SERV.

TWO-SPOTTED ENCHOPHYLLUM, *E. binotatum*, (Say.) Appendix to
Long's Exped., p. 301. Common on numerous plants
and trees. No. 641, male; 642, female.

Var. *a*. Color brown. No. 643.

BROAD-FOOTED ENCHOPHYLLUM, *E. latipes*, (Say.) App. to Long's
Exp., p. 302. No. 644, female.

ENTILIA. GERMAR.

NOTCH-BACKED ENTILIA, *E. sinuata*, (Fab.) Entom. Syst. Suppl.,
p. 513. No. 645, male; 646, female.

Sub-species **torva*. Front somewhat concave, causing
the anterior foliole to incline slightly forward. No. 647,

HOLLOW-BACKED ENTILIA, *E. concava*. (Say.) App. to Long's Exp.,
p. 301. That part of the generic definition which
represents the thorax as "foliaceous and deeply notched"
does not apply to this species. In all other respects
this is so closely related to the preceding as scarcely to
call for a generic separation. Both species occur on
various herbs and trees, particularly on the Canada
thistle, where the larvæ are, like plant-lice, attended by
ants, which protect them and subsist upon their saccharine
secretions. No. 648, male; 649, female.

*CARYNOTA.

(Gr. *καρυα*, roundish, *νωτος*, the back.) Head broad, triangular; thorax in form of a half cone, not compressed above into a sharp or foliaceous edge; elytra with five terminal cells, the apical triangular with its end rounded; border broad, slightly wrinkled; nerves strong, elevated. Allied to *Gargara*, from which genus however, our species are excluded by the form of the head and of the apical cellule.

BUTTERNUT CARYNOTA. *C. mera*, (Say.) Jour. Acad. Nat. Sci., vi. 301. On the butternut. No. 650, female.

OAK, OR ARCH-STRIPED CARYNOTA, *C. arquata*, (Say.) Jour. Acad. Nat. Sci., vi. 302. On different species of oaks. No. 651, female; 652, male (?)

SMILIA. GERMAR.

UNADORNED SMILIA, *S. inornata*, (Say.) Jour. Acad. Nat. Sci., vi. 299. Common on oaks, chestnut, hickory, &c. No. 653, male (?); 654, female.

Var. *a*. Edge of the keel not fuscous-black. No. 655.

UNARMED SMILIA, *S. inermis*, (Fab.) Ent. Syst. iv. 15. On oaks. No. 656, male; 657, female.

V-MARKED SMILIA, *S. vau*, (Say.) Jour. Acad. Nat. Sci., vi. 299. Abundant, particularly upon the white oak. No. 658, female.

Var. *a*. Elytra fuliginous throughout. No. 659.

b. Elytra hyaline throughout. No. 660.

c. The thoracic bands margined with black. No. 661.

d. Front tinged with sanguineous. No. 662.

e. Head white. No. 663.

f. Head white, with sparse large black punctures. No. 664.

g. Posterior thoracic band obsolete. No. 665.

h. Bands obsolete; a fulvous spot above each eye. No. 666.

i. White; apex of the thorax and a spot above each eye fulvous. No. 667.

j. Apex of the thorax white. No. 668.

CHESTNUT SMILIA, **S. castanea*. Fuscous, more or less green when recent; head, anterior edges of thorax and all beneath, bright yellow; elytra hyaline with an apical and large longitudinal basal spot, fuscous. Length, male 0.25, female 0.30. Common on the chestnut. No. 669, male; 670, female.

Var. *a*. Face with scattered fuscous dots. No. 671.

OAK SMILIA, **S. querci*. Black, with an abbreviated bright yellow dorsal vitta, which is commonly interrupted near its tip; legs pale yellow. Length, 0.22. On oaks. No. 672, male.

Var. *a*. Dorsal vitta not interrupted. No. 673.

STRIPED SMILIA, *S. vittata*, (Amyot and Serv.) Hemipt. p 539. Common on the red and black oak. No. 674, female.

Subsp. **guttata*. The oblique stripe replaced by a few greenish spots or dots. No. 675.

EARED SMILIA, **S. auriculata*. Bright green, when faded mottled with yellow, immaculate; humeral angles somewhat salient, rounded; keel evenly rounded, much elevated, anteriorly advanced and overhanging the head; elytra scarcely exceeding the tip of the thorax. Length, from the front 0.35, from the anterior end of the keel 0.40; height 0.23. On oaks. Rare. No. 676, male.

*CYRTOISA.

(Gr. κυρτος, curved, hump-backed.) Humeral angles rounded, not salient; dorsum compressed-foliaceous, forming a regularly arched keel highest near its middle, and at most with a slight concavity posteriorly; apical cellule triangular, its end rounded. Differs from Smilia in having the keel most elevated in its middle instead of anteriorly.

MARBLED CYRTOISA, *C. marmorata*, (Say.) Jour. Acad. Nat. Sci., vi. 301. On oaks. No. 677, female.

WINDOWED CYRTOISA, **C. fenestrata*. Yellow marbled with rufous; a pellucid spot behind the summit of the keel and a smaller one half way to the apex; an oblique yellow vitta below the anterior spot, margined with fuscous or sanguineous; tip of the thorax reaching beyond the terminal cells of the elytra. Male black, the pellucid

spots almost obsolete and the yellow vitta replaced by a few yellow dots. Length 0.25. On oaks. No. 678, male; 678 (bis) female.

CERESA. AMY. and SERV.

TWO-HORNED CERESA, *C. diceros*, (Say.) App. to Long's Exp., p. 299. Occurs like the following, on various trees and shrubs. No. 679, female.

BUFFALO CERESA, *C. bubalus*, (Fab.) Ent. Syst., iv. 14. No. 680, male; 681, female.

Var. *a*. Sides of the thorax mottled with fuscous. No. 682.

b. Under side black-brown. No. 683.

*TELAMONA.

(From *Telamones*, a synonym of *Atlantes*, in allusion to the enormous backs of these insects.) Humeral angles projecting, pointed and ear-like: dorsum compressed-foliaceous, the keel abruptly elevated at one or both its ends, forming a somewhat square crest or foliole: thorax nearly or quite reaching the tips of the elytra, with elevated longitudinal lines on each side: apical cellule triangular, its end rounded. The squarish dorsal crest forms a marked distinction between the genus here proposed, and that of *Thelia*, to which it is most nearly related.

ONE-COLORED TELAMONA, **T. unicolor*. Yellow, immaculate, apex of the thorax tinged with fuscous; summit and angles of the crest rounded. Length 0.45, height 0.25. No. 684, female.

BANDED TELAMONA, **T. fasciata*. Yellow; thorax anteriorly and at its apex, and an oblique band crossing the posterior part of the crest fuscous; head and anterior margin of the thorax yellow, with numerous black punctures and a black dot above each eye; crest longer at its base than above, anterior end more concave than the posterior, angles rounded. Length 0.38, height 0.20. Found on walnut trees. No. 685, female.

HOLLOW-CRESTED TELAMONA, **T. concava*. Brown; a large spot on each side and a transverse band behind the crest, yellow, with sinuous black margins, the spot traversed by an

interrupted flexuous black line ; summit of the crest slightly concave posteriorly, with a small yellow spot ; crest contracted at its base before and more strongly behind, its posterior angle rectangular, its anterior rounded and more elevated. Length 0.42, height 0.22. No. 686, female.

BEECH TELAMONA, **T. fagi*. Black, varied with obscure cinereous ; anterior half of the crest double the height of the posterior half, and elevated from it perpendicularly. Length 0.40. Taken on beech trees. No. 687, male.

WOODBINE TELAMONA, *T. ampelopsidis*, (Harris.) Inj. Ins. p. 180. On the woodbine. No. 688, female.

SAD TELEMONA, **T. tristis*. Fuscous mottled with pallid ; crest with a white line on its posterior base and one or two small pellucid spots in its upper edge ; three black dots over each eye ; posterior angle of the crest nearly rectangular and almost as high as the anterior, the upper edge nearly straight. Length 0.35. Found on bushes of hazelnut, &c. No. 689, female.

HAZELNUT TELAMONA, **T. coryli*. Pale dull yellow ; an abbreviated band occupying the anterior end of the crest, a curved and fuscous-margined band crossing its posterior end, and the apex of the thorax, ferruginous ; form of the crest similar to that of *tristis*. Length 0.32. Taken on hazelnut bushes. No. 690, female.

OAK TELAMONA, **T. querci*. Green, freckled with yellow, fading to dull yellow punctured with black ; crest with a pale yellow vitta on its posterior edge ; angles of the crest rounded, the anterior much higher than the posterior. Length 0.40. On different species of oak. No. 691, male ; 692 female.

RECLIVATE TELAMONA, **T. reclivata*. Greenish white ; a sub-interrupted band crossing the back part of the crest, a stripe at its posterior base, and the apex of the thorax brownish black ; anterior end of the crest strongly inclined backwards, rectilinear. Length 0.35. On oaks and chestnut. No. 693, female.

THELIA. AMY. and SERV.

TWO-SPOTTED THELIA, *T. bimaculata*, (Fab.) Entom. Syst. iv. 10.

Occurs on the locust. No. 694, male.

SINGLE-STRIPED THELIA, *T. univittata*, (Harris.) Inj. Ins., p. 180.

On oaks. No. 695, male ; 696, female.

THORN-BUSH THELIA, **T. cratægi*. Fuscous varied with black and white ; thorax with two broad white bands margined with black, the anterior narrowed on the front and notched on each side at the base of the foliole. Length, 0.34 ; height, 0.13 ; to the apex of the foliole 0.26. On the thorn. No. 697, female.

TRAGOPA. GERM.

DORSAL TRAGOPA, **T. dorsalis*. Greenish-white, polished ; elytra hyaline ; occiput, pectus, and large dorsal spot sending a branch towards each eye, black. Males black, with the face, apex of the thorax, the abdomen and feet greenish-white. Length, 0.20. On grape vines. No. 698, male ; 699, female.

UROXIPHUS. AMY. and SERV.

WALNUT UROXIPHUS, *U. caryæ*. Dull brown ; elytra towards the apex obscure-cinereous ; abdomen and annulus on the tibiæ pale yellowish ; sternum pruinose-white. Length, male, 0.30 ; female, 0.37. On the walnut and pig-nut. No. 700, male ; 701, female.

Var. *a*. Femurs rufous, tibiæ and base of the hind tarsi pale yellow. No. 702.

FAMILY CERCOPIDÆ.

APHROPHORA. GERM.

FOUR-SPOTTED APHROPHORA, *A. quadrinotata*, (Say.) Jour. Acad. Nat. Sci., vi. 304. Taken on grape vines. No. 703, male ; 704, female.

Var. *a*. Elytra nearly hyaline. No. 705.

LEPYRONIA. AMY. and SERV.

FOUR-CORNERED LEPYRONIA, *L. quadrangularis*, (Say.) Jour. Acad. Nat. Sci., iv. 335. Common in autumn and spring in groves of the sugar-maple, where numbers may often be met with, drowned in the vessels of sap. No. 706, male; 707, female.

PARALLEL-MARKED LEPYRONIA, *L. parallella*, (Say.) App. to Long's Exp., p. 303. Common on the white pine. No. 708, male; 709, female.

SARATOGA LEPYRONIA, **L. saratogensis*. Pale fulvous varied with white; anterior and posterior margins of the vertex parallel. Closely related to *parallella*, but that has the vertex crescentiform, is much darker colored, and is confluent nigro-punctate. Here the punctures are uncolored. Length, 0.40. Common on the pitch pines of Saratoga plains, and is sometimes met with on the white pine also. No. 710, male; 711, female.

Var. *a*. Dorsal vitta obsolete; elytra pellucid-white. No. 712.

CLASTOPTERA. GERM.

OBTUSE CLASTOPTERA, *C. obtusa*, (Say.) Jour. Acad. Nat. Sci., iv. 339. If this is not the *C. achatina*, Germ., that species is unknown to me. No. 713, male; 714, female.

TESTACEOUS CLASTOPTERA, **C. testacea*. Testaceous; scutellum rufous; elytra with a polished callous-like black dot near the apex. Length, 0.20. Found on oaks and pines. No. 715, female.

Var. *a*. A black callous-like dot on each side of the pectus. No. 716.

b. Pectoral dots present, elytral dots wanting. No. 717.

c. The black dots wanting, both on the elytra and pectus. No. 718.

PINE CLASTOPTERA, **C. pini*. Black; head yellow, with a black band on the anterior margin of the vertex; thorax with a yellow band anteriorly; elytra with a broad hyaline

outer margin interrupted in the middle, and a black callous dot near the apex. Length, 0.14. Found chiefly on pines. No. 719, male.

Var. *a*. A ferruginous dot on the apex of the scutel. No. 720.

b. The yellow thoracic band widely interrupted. No. 721.

PROTEUS CLASTOPTERA, **C. proteus*. Head bright yellow, a black band on the anterior margin of the vertex and a broader one on the front; front polished, without transverse striæ; a callous black dot near the apex of the elytra; legs yellowish-white, tarsi black. Length, 0.16; males slightly smaller. Abundant on the paniced dog-wood, (*Cornus paniculata*.) Closely allied to the *C. atra*, (Germar,) but on examining a host of specimens, not one occurs in which the legs are annulated with black or fuscous. No. 722, female.

This pretty insect, though so small in size, presents an astonishing number of sub-species and varieties, so clearly and distinctly marked that at first glance they would be confidently regarded as well characterized species. The following are the more prominent, though by no means all, of the varieties that occur:

Sub-sp. 1. *flavicollis*. Thorax entirely yellow.

Var. *a*. Elytra yellow. No. 723.

b. Elytra with an oblique blackish vitta. No. 724.

Sub-sp. *cincticollis*. Thorax with a black band.

Var. *a*. An interrupted black band on the anterior margin of the thorax. No. 725.

b. An entire black band on the anterior margin of the thorax. No. 726.

c. Thoracic band crossing the disk instead of the anterior margin. No. 727.

d. Band on the disk of the thorax, and scutel black. No. 728.

Sub-sp. *maculicollis*. Thorax with one or two discoidal spots.

Var. *a*. A black spot on the disk and interrupted band anteriorly. No. 729.

b. A black spot on the disk and anterior band entire. No. 730.

c. Two black spots on the disk of the thorax. No. 731.

Sub-sp. *nigricollis*. Thorax black, with a yellow band forward of the disk.

Var. *a*. The black band on the anterior margin of the thorax interrupted. No. 733.

b. The band continuous, No. 734.

c. Scutel black, with a yellow dot at its base. No. 735.

d. Scutel entirely black. No. 736.

FAMILY TETTIGONIIDÆ.

TETTIGONIA. GEOFF.

FORK-STRIPED TETTIGONIA, *T. bifida*, (Say.) Jour Acad. Nat. Sci., vi. 313. On grass in meadows. No. 737, male; 738, female.

Var. *a*. The usual three white dots in the black frontal spot confluent, forming a lunule. No. 739.

b. Two white dots only on the front. No. 740.

c. The orange color on the sides of the front replaced by black. No. 741.

THREE-DOTTED TETTIGONIA, **T. tripunctata*. White; vertex with two black dots on the disk and a third on the apex; thorax with two pale brown bands; elytra pellucid-white, the longitudinal nervures brown, except at their tips; head longer and more pointed than in the preceding species. Length, 0.20. Taken on dog-wood. No. 742, male.

PROCONIA. LEPEL. and SERV.

FOUR-STRIPED PROCONIA, *P. quadrivittata*, (Say.) Jour. Acad. Nat Sci., vi. 312. In having the vertex flattened, this and the succeeding species are widely separated from the two foregoing. Common, on various shrubs. No. 743, male; 744, female.

- Var. *a.* Spots on the thorax sanguineous. No. 745.
b. Thorax with two black spots at its base. No. 746.
c. Thorax margined with black at its base. No. 747.
d. Disk and base of thorax green, immaculate. No. 748.
e. Thorax with a green mark shaped like a trident, based on its posterior margin. No. 749.

AULACIZES: AMY. and SERV.

TENDER-FOOTED AULACIZES, *A. mollipes*, (Say.) Jour. Acad. Nat. Sci., vi. 312. Common on the grass of meadows and pastures. No. 750, male; 751, female.

NEW-YORK AULACIZES, **A. noveboracensis*. Yellow; elytra and large spot at the base of the thorax, olive-green; no black vitta on the sides of the pectus; head shorter, broader, and its apex more obtuse, than in *mollipes*. Length, 0.33. Rare. On grass in meadows. No. 752, female.

*HELOCHARA.

(Gr. ἑλος, a marsh, χαίρω, to rejoice.) Head obtuse-triangular, broader than long, slightly broader than the thorax, the transversely-striated front reflected over on to the anterior sides of the vertex; vertex with a slight longitudinal stria; ocelli on the vertex, farther from each other than from the eyes; tips of the male antennæ knobbed; elytra with five terminal and three discoidal cells. By its knobbed antennæ, this genus occupies a similar rank in the sub-family *Tettigonides*, that *Idiocerus* does in that of *Jassides*.

COMMON HELOCHARA, **H. communis*. Dark green; females grass-green, when faded variously mottled with tawny yellow; beneath, more or less black, legs testaceous. Length, 0.20. On grass in marshy situations, often excessively numerous. No. 753, male; 754, female.

Var. *a.* The usual transverse row of large punctures on the foreside of the thorax obsolete. No. 755.

EVACANTHUS. LEPEL. and SERV.

ORBITAL EVACANTHUS, **E. orbitalis*. Black, shining; orbital margins, antennæ and legs, tawny white; elytra deep fuscous, nerves and large spot at the apex of the outer margin white; face with a tawny white, transverse spot or band above. Length, 0.18, to tip of female abdomen 0.20. On dogwood, the last of July. Rare. No. 756, male.

GYPONA. GERM.

YELLOW-STRIPED GYPONA, **G. flavilineata*. Pale green, immaculate; thorax with eight pale yellow vittæ, the middle ones common to the vertex and scutel. *Tettigonia 8-lineata*, var. *a*, of Say. Having never met with specimens possessing rosaceous stripes and nervures, and this insect being larger in size than the *8-lineata*, I am induced to regard it as a distinct species. Length, 0.35 to 0.45. Common on oaks, maple, walnut, &c. No. 757, male; 758, female.

RED-MOTTLED GYPONIA, **G. scarlatina*. Dull yellowish brown; elytra with rosaceous nerves and dots; thorax without vittæ; common disk of the elytra sparsely dotted with black; length, 0.40. No. 759, female.

PENTHIMIA. GERM.

AMERICAN PENTHIMIA, **P. americana*. Black; elytra white towards the apex; two dots on the anterior edge of the vertex, and a spot on each outer angle of the thorax sanguineous or rufous. Female, with the vertex, thorax, scutel and venter, sanguineous. Closely allied to the European varieties *hemorrhoca* and *sanguinicollis*, (Fab.) but is a size larger. Length, 0.23. Rare. Taken on the sugar maple. No. 760, male; 761, female.

ACOCEPHALUS. GERM.

YELLOW ACOCEPHALUS, **A. vitellinus*. Yellow; elytra longer than the abdomen, with pellucid spots, and on the margins towards the apex a few black dots. Length, 0.26. Found on the sugar maple. No. 762, male.

Var. *a*. Four faint tawny yellow vittæ on the thorax, and an oblique tawny band across the middle of the elytra. No. 763, female.

CÆLIDIA. GERM.

BANDED CÆLIDIA, *C. subbifasciata*, (Say.) Jour. Acad. Nat. Sci., vi. 310. Found on beech trees. I have also taken this species in Kentucky and Illinois. No. 764, female.

GARDEN CÆLIDIA, *C. olitoria*. (Say.) Jour. Acad. Nat. Sci., vi. 310. Taken on raspberry bushes. No. 765, female.

BYTHOSCOPIUS. GERM.

BLACK-BACKED BYTHOSCOPIUS, **B. tergatus*. Sordid green, immaculate; elytra smoky; tergum black; beneath greenish yellow; tarsi pale brown. Length, 0·30. On willows. No. 766, male.

ONE-COLORED BYTHOSCOPIUS, **B. unicolor*. Greenish-yellow, immaculate; elytra hyaline; length, 0·28. Taken on flowers of goldenrod. No. 767, female.

HALF-CLOTHED BYTHOSCOPIUS, *B. seminudus*, (Say.) Jour. Acad. Nat. Sci., vi. 307. Found on birch trees. No. 768, female.

SADDLED BYTHOSCOPIUS, *B. clitellarius*, (Say.) Jour. Acad. Nat. Sci., vi. 309. On various herbs and shrubs. No. 769, male; 770, female.

PINE BYTHOSCOPIUS, **B. strobi*. Yellowish-brown; elytra with three white bands, and closely inscribed with fuscous points and lines, outer margin with small fuscous spots; beneath brown; legs pallid, with spine-bearing black dots. Length, 0·20. Common on pines in May. No. 771, male; 772, female.

IDIOCERUS. LEWIS.

WEeping IDIOCERUS, **I. lachrymalis*. Brown varied with white; elytra hyaline, immaculate, nerves fuscous; a black spot at the anterior edge of each eye; two remote black dots on the fore side of the vertex commonly connected by a transverse black line; scutellum with a transverse black spot on the disk and two triangular ferruginous

spots at the base. Length, 0·28. Taken on poplar and walnut trees. No. 773, male; 774, female.

Var. *a*. The black frontal line prolonged to the spots forward of the eyes. No. 775.

b. The usual small black spot beneath each ocellus wanting. No. 776.

c. The black frontal line wanting. No. 777.

d. One or two small four-sided discoidal cells in the elytra in addition to the usual number. No. 778.

ALTERNATE-MARKED IDIOCERUS, **I. alternatus*. Brown varied with white; elytra hyaline, immaculate, nerves fuscous with white alternations; two remote black dots on the anterior edge of the vertex; scutel with two dots on its disk and two triangular spots at its base black. Length, 0·22. Common, on willows. No. 779, male; 780, female.

SPOTTED-WINGED IDIOCERUS, **I. maculipennis*. Chestnut-brown varied with white; elytra hyaline, with a large fuscous spot on the middle and another at the apex of the outer margin, with an intervening white spot; a faint white spot towards the base of the sutural margin. Length, 0·25. Taken on thorn bushes. No. 781, female.

SUTURE-STRIPED IDIOCERUS, **I. suturalis*. Yellowish white; elytra hyaline with a dusky vitta on the suture, and two dusky spots on the base of the scutel. I have never met with the males of this and the following species, but their facial ocelli and elytral neuration indicate this to be their generic place. Length, 0·25. Taken on chestnut trees. No. 782, female.

PALE IDIOCERUS, **I. pallidus*. Greenish white, immaculate; elytra hyaline. Length, 0·22. On poplars and willows. No. 783, female.

PEDIOPSIS. BURM.

GREEN PEDIOPSIS, **P. viridis*. Light green, immaculate; elytra pellucid, almost hyaline. Length, 0·18. No. 784, female.

THREE-SPOTTED PEDIOPSIS, **P. trimaculatus*. Dull brown; scutel with a black spot at each angle, the posterior one sometimes obsolete; elytra with pellucid white spots situated one on the apex, one on the disk, and a third anteriorly, scutellar region obscure cinereous; face whitish. Length, 0·18. No. 785, female.

ATHYSANUS. BURM.

To this genus we refer those species which differ from *Macropsis* and *Pediopsis* in having the ocelli between the vertex and the face, and from *Jassus* in having the elytral suture straight.

VARIABLE ATHYSANUS, **A. variabilis*. Sulphur-yellow; elytra commonly with an oblique black vitta, their tips pellucid; vertex, thorax and scutel often fulvous or black. Length, 0·20. Abundant on birch trees, in June. No. 786, female.

Var. *a*. Dull yellowish-white throughout. No. 787.

b. Bright sulphur-yellow throughout. No. 788.

c. An oblique black stripe on each elytron. No. 789.

d. Vertex, thorax and scutel tawny yellow. No. 790.

e. Vertex and thorax tawny yellow, scutel black. No. 791.

f. Vertex, thorax and scutel black. No. 792.

SPRUCE-TREE ATHYSANUS, **A. abietis*. Black, shining; head light yellow, mouth and two bands on the vertex confluent at their ends, black; middle of the sutural edge of the elytra with a white streak. Length, 0·20. Taken on the black spruce. No. 793, female.

WINDOWED ATHYSANUS, **A. fenestratus*. Brownish-black; face and scutel rufous; elytra each with a pellucid spot near the apex, another on the disk, and a third opposite this last on the sutural margin. Length 0·20. On birch trees. No. 794, female.

SMALLER ATHYSANUS, **A. mincr*. Cinnamon-yellow; elytra with a discoidal and large apical spot hyaline. Length, 0·18. Common on birch trees. No. 795, female.

BEECH-TREE *ATHYSANUS*, **A. fagi*. Elytra fuscous, immaculate; scutel, face and pectus black; venter and legs light yellow. Length, 0·18. Taken on beech trees. No. 796, female.

BLACK-NOSED *ATHYSANUS*, **A. nigrinasi*. Pale yellow, lower part of the face black or fuscous. Length, 0·18. Common, particularly upon the hornbeam, (*Carpinus americana*.) Presents many varieties. No. 797, female.

AMBLYCEPHALUS. CURTIS.

CURTIS'S *AMBLYCEPHALUS*, **A. curtisii*. Greenish yellow; two dots on the vertex, band on fore part of the thorax, and six vittæ on each elytron, black; beneath black. Length 0·15. Common particularly on the grass of meadows. No. 798, male; 799, female.

SAY'S *AMBLYCEPHALUS*, **A. sayii*. Pale yellowish, without dots; elytral cells partially margined with fuscous or black, nerves white. Length 0·13. Abundant on grass in pastures and meadows. No. 800, male; 801, female.

Var. *a*. A black spot on the base of the thorax. No. 802.

b. Three black spots on the base of the thorax. No. 803.

c. Only the apical cells margined with fuscous at their tips. No. 804.

MELSHEIMER'S *AMBLYCEPHALUS*, **A. melsheimerii*. Pallid, base of the tergum black; elytra pellucid, nerves white. Length 0·10. Common on grass. No. 805, male; 806, female.

INIMICAL *AMBLYCEPHALUS*, *A. ? inimicus*, (Say.) Jour. Acad. Nat. Sci., vi. 305. Though this much resembles the species named *Sayii*, above, it differs from this genus by the length of its elytra, and from *Jassus* by its striated front and the number of its discoidal and apical cells. It probably forms the type of a separate genus. Common on grass, and its larva has been said to depredate upon the roots of young wheat. No. 807, male; 808, female.

Var. *a*. Nerves white, cells margined with fuscous. No. 809.

- b. Two smaller dots between the ordinary ones on the head. No. 810.
- c. Two dots only on the neck. No. 811.
- d. Dots on the neck all wanting. No. 812.

JASSUS. FAB.

FRECKLED JASSUS, **J. irroratus*, (Say.) Jour. Acad. Nat. Sci., vi. 308. Common on herbage. No. 813, male; 814, female.

Var. *a*. A transverse row of five white dots on the anterior edge of the head. No. 815.

YELLOW-BACKED JASSUS, **J. fulvidorsum*. Head, thorax and scutel sordid yellow, uninscribed; elytra white, closely inscribed with fuscous lines and points, and on the outer margin irregular spots. Length 0.25. On pines. No. 816, male; 817, female.

POINTED JASSUS, *J. ? acutus*, (Say.) Jour. Acad. Nat. Sci., vi. 306. Found on hornbeam. No. 818, male.

* ERYTHRONEURA.

(Gr. *ερυθρος*, red, *νευρον*, nerve; in allusion to the color of portions of the elytral nerves in several of the species.) Head crescentiform, about as broad as the thorax; vertex rounded down to the front without an angular edge; ocelli between the vertex and the front, almost as near each other as to the eyes: elytra without closed cells in the disk; apical cells four, longish; middle apical nerve simple. Forward of the transverse nerve the exterior and middle nerves are sometimes obsolete. For a group of our small *Jassides*, whose elongated linear bodies give them the aspect of *Tettigoniides*, no place appears among the genera defined by Amyot and Serville. This and the following genus is therefore proposed for their reception.

WOUNDED ERYTHRONEURA, **E. vulnerata*. Fulvous-brown spotted and lined with whitish; elytra with an abbreviated yellowish-white vitta on the outer margin, interrupted near the middle by an oblique black line, and towards the apex by an oblique sanguineous one; tips dusky, with whitish nervures and spots; a whitish medial line common to the vertex, thorax and scutel; beneath

black, legs pallid. Length 0·12, On raspberry bushes, grape vines and other situations where the foliage is dense, often in great numbers. No. 819, male; 820, female.

GRAPE-VINE ERYTHRONEURA, *E. vitis*, (Harris.) Inj. Ins., p. 184.
Inhabits with the preceding. No. 821, female.

ALLIED ERYTHRONEURA, **E. affinis*. Pale yellow; elytra hyaline, spotted with light yellow, with a black dot on the inner margin towards the apex, and a broad yellowish brown band on the base. Allied to *basillaris* Say, but readily distinguished, being destitute of sanguineous markings. Length 0·12. No. 822, female.

THREE-BANDED ERYTHRONEURA, **E. tricineta*. Pale yellow, with three broad bands, the anterior velvet-black, occupying the thorax and basal half of the scutel; the middle bright ferruginous ending outwardly in black, forward of the middle of the elytra, the posterior dusky brown, on the apex. Length 0·12. No. 823, female.

Var. *a*. Anterior band sanguineous. No. 824.

OBLIQUE-STRIPED ERYTHRONEURA, *E. obliqua*, (Say.) Jour. Acad. Nat. Sci., iv. 342. No. 825, male.

BEAN-VINE ERYTHRONEURA, *E. fabæ*, (Harris.) Inj. Ins., p. 186.
No. 826, male; 827, female.

• EMPOA.

(Gr. *εῦ*, upon, *πῶς*, herbage.) Differs from *Erythroneura* in having the apical nerve widely forked, forming a triangular apical cell, which is shorter than the three other terminal cells.

OAK EMPOA, *E. querci*. White; elytra pellucid, with three blackish dots in a transverse row behind the middle. Length 0·12. On oaks, sometimes excessively numerous. No. 828, female.

SCARLET EMPOA, *E. coccinea*. Scarlet-red, immaculate, pectus and venter orange, elytra brownish-pellucid. Length 0·10. Taken on pines. No. 829, male.

FAMILY PSYLLIDÆ.

PSYLLA. GEOF.

THREE-DOTTED PSYLLA, **P. tripunctata*. Wax-yellow, dorsum black; legs and antennæ pale yellow, the latter black at the tips; elytra hyaline, nerves brown, beyond the furcation widely margined with smoky-fulvous, a blackish dot on the middle of the terminal margin of each of the inner apical cells. Length 0·16. No. 830, female.

FOUR-LINED PSYLLA, **P. quadrilineata*. Bright fulvous; elytra hyaline, nerves blackish; four whitish longitudinal lines on the middle of the metathorax; abdomen black with a yellow band at its base. Length 0·12. No. 831, female.

HORNBEAM PSYLLA, **P. carpini*. Light-green or greenish yellow; elytra hyaline, nerves light green. Length 0·16. Common on the hornbeam, in July. No. 832, male; 833, female.

ANNULATED PSYLLA, **P. annulata*. Straw yellow; legs white; elytra hyaline, nerves straw yellow; antennæ black, basal half straw-yellow annulated with black. Length 0·15. Occurs on the sugar-maple. No. 834, male; 835, female.

LIVIA. LAT.

VERNAL LIVIA, **L. vernalis*. Bright ferruginous; pectus and tips of antennæ black; legs ferruginous-pallid. Length 0·15. Found in spring in vessels of sap of the sugar-maple. No. 836, male; 837, female.

BLACK-LEGGED LIVIA, **L. femoralis*. Bright ferruginous; pectus, four forward femurs and tips of the antennæ black. Perhaps not distinct from the preceding. Length, 0·15. Taken on a pine tree, in July. No. 838, female.

FAMILY APHIDÆ.

APHIS. LINN.

- APPLE-TREE APHIS, *A. mali*, (Fab.) Ent. Syst. iv. 216. Common on the under side of the leaves and tips of the young branches of the apple-tree. No. 839, male.
- CHERRY-TREE APHIS, *A. cerasi*, (Fab.) Ent. Syst. iv. 211. Common on the under side of the leaves of the garden cherry, (*Cerasus vulgaris*, Mill.) No. 840, male.
- CHERRY-INHABITING APHIS, **A. cerasicolenis*. Palegreenish yellow; antennæ and legs black, base of the femurs pallid; nerves of the fore wings dusky, stigma pellucid white; abdominal horns quite short. When irritated, the legs and antennæ instantly emit from their pores a bluish white cotton-like substance, which remains adhering to them, resembling fine mould. Length 0·20 to the tips of the wings. On the common black-cherry-tree, (*Cerasus serotina*, DC.) No. 841, male.
- BERBERRY APHIS, **A. berberidis*. Black; pectus and abdomen pale yellow, tip black; legs dusky; larva and pupa pale, with a green or black vitta on each side of the back, parallel with the outer margin. Length, 0·10. On the under side of berberry leaves. No. 842, male; 843, female.
- CABBAGE APHIS, *A. brassicae*, (Linn.) Syst. Nat. ii. 734. Common on the under side of cabbage leaves. No. 844, male.
- SILK-WEED APHIS, **A. asclepiodis*. Black; abdomen pale green; sides with two rows of impressed fuscous dots, three in the lower, larger, five in the upper; abdominal horns nearly equalling the tip; stigma smoky-whitish; nerves brown; the costal whitish. Length 0·15. On the lower surface of young leaves of the common silk-weed. No. 845, male.
- DOGWOOD-LEAF APHIS, **A. cornifoliae*. Apterous females black, subpruinose, obovate; legs pale yellow, feet black; antennæ pale yellow, tips black; horns nearly equalling the truncated tip of the abdomen. Length, 0·05, to tip of abdomen. On the under surface of the leaves of *Cornus paniculata*. No. 846, female.

THORN-LEAF APHIS, **A. crataegifoliae*. Black; abdomen green, with a row of blackish dots along each side; nerves of the fore wings whitish, black at their tips; tibiae, except at their tips, and base of the femurs, green; horns nearly half equalling the tip of the abdomen. Length, 0.15. On the leaves of *Crataegus punctata*, corrugating them. No. 847, male.

BIRCH-INHABITING APHIS, **A. betulæcolens*. Sulphur-yellow; antennæ deep black, two basal joints sulphur-yellow, the following joints white at their bases; stigma pellucid yellowish; nerves black, the costal and marginal sulphur-yellow, base of the forked nerve hyaline; horns very short. Length, 0.18. No. 848, male.

MAPLE-TREE APHIS, *A. aceris*, (Linn.) Syst. Nat. ii. 736. Our insect appears to correspond with the brief description given of this species. Occurs on the *Acer pennsylvanicum*. No. 849, male.

ELDER-LEAF APHIS, **A. sambucifoliae*. Black; tibiae and base of the femurs pallid; stigma dusky; nerves black, the furcate one hyaline at its base. Length, 0.15. On the under side of the leaves of the elder. No. 850, male.

PINE-INHABITING APHIS, **A. pinicolens*. Straw-yellow, densely pruinose; antennæ black, bases pallid, with a fuscous annulus; fore wings with a fuscous spot on the apex of each nerve; nerves brown, hyaline at their bases, the costal straw-yellow; horns very short. Length, 0.25. Solitary on the pine. No. 851, male.

POPLAR-LEAF APHIS, **A. populifoliae*. Chestnut-brown, pruinose; legs hairy, black, above the knees pale brown; stigma smoky fulvous, margined with black; nerves brown; tergum with two dorsal rows of impressed, quadrate, fuscous spots, and on each side two rows of impressed dots; horns equalling a third of the distance to the tip. Length, 0.22. On the leaves of the *Populus grandidentata*. No. 852, male.

CONE-FLOWER APHIS, **A. rudbeckiæ*. Red; antennæ and legs black, basal half of the femurs pale yellow; horns equalling the tip; stigma yellowish; nerves brown, the costal sulphur-yellow; Length, 0.20. Infests the upper part of the stalks of *Rudbeckia laciniata*, *Solidago serotina* and *S. gigantea*. No. 853, male.

LACHNUS. ILLIG.

SPRUCE-TREE LACHNUS, **L. abietis*. Apterous females pubescent, broad oval, blackish clouded with lurid brown, with a faint cinereous dorsal vitta; venter lurid, pruinose, with a black spot near the tip; antennæ sordid-white, with a black annulus at the apex of each joint. Length 0·15 to tip of the abdomen. Occurs on the *Abies nigra*. No. 854, female.

OAK-LEAF LACHNUS, **L. quercifoliae*. Light yellow; antennæ pelucid white, with a slender black annulus at the tip of each joint; fore wings with a blackish spot on the apex of each nerve and a deep black dot on the base of the curved apical nerve; stigma whitish. Length to tip of wings 0·15. On the leaves of the white oak. No. 855, male.

WILLOW LACHNUS, **L. salicellis*. Black; tibiæ and base of the antennæ obscure pallid; base and costal margin of the fore wings yellowish-white. Length 0·08. On the young succulent twigs of willow trees. No. 856, male.

ALDER-LEAF LACHNUS, **L. alnifoliae*. Apple-green; antennæ greenish-white, with four black annuli; legs greenish-white, tarsi, knees, and line on the posterior side of the tibiæ black; wings hyaline, the three oblique nerves black. Length, 0·10. On alder leaves. No. 857, male.

ELM LACHNUS, *L. ulmi*, (Linn.) Syst. Nat. ii. 733. Solitary, on the under side of elm leaves. No. 858, male.

POPLAR LACHNUS, *L. populi*, (Linn.) Syst. Nat. ii. 736. On the under side of the young leaves of *Populus grandidentata*. No. 859, male; 860, larva.

ERIOSOMA. LEACH.

APPLE-TREE BLIGHT, *E. lanigera*, (Hausman.) Illiger's Magaz. vol. i. p. 440. *Myzoxylus mali*, (Blot.) Mem. Soc. Agricult. de Caen, 1830, p. 38. On the bark of young branches of the apple, to which tree, in Europe, it has been a great pest. Commonly only solitary individuals are here found, and in but one instance, have I met with it clustered and covering a limb as described by foreign writers. No. 861, male.

APPLE-ROOT BLIGHT, **E. pyri*. Black, more or less pruinose, with a tuft of cotton-like down on the tergum and commonly a smaller one on the head; fore wings hyaline, with a large black stigma and nerves, the externo-medial nerve hyaline towards its base; inner edge black from the base to the apex of the first nerve, hyaline beyond. Length, 0·20. Common on the wing in groves, in autumn. On the roots of a young apple tree brought me from a nursery, excrescences were observed, the crevices in which were found to be covered with small lice-like larvæ, among which some winged individuals occurred, which proved on examination to be this species, from which circumstance its habits are inferred and its name bestowed. No. 862, male.

ALDER BLIGHT, **E. tessellata*. Dull bluish-black; tergum with the segments marked by strongly impressed lines and covered by white down in square checker-like spots. Length, 0·16. On the under side of branches of the alder, (*Alnus rubra*, Marsh.) crowded together and concealed beneath a dense covering of snow-white down. I have searched in vain for winged individuals of this species. No. 863.

BEECH-TREE BLIGHT, *E. imbricator*. Black; three last segments of the abdomen blue-pruinose; stigma brown; longitudinal nerve and a line on the middle of the inner margin black. Female (?) winged; abdomen fulvous, with a black spot on the disk; legs pallid. Larva pallid, with 2 fuscous dorsal stripes; posterior half of the abdomen covered with a tuft of cotton-like down, from which proceeds two longer and coarser filaments. Length, 0·22. On the under sides of the branches of the beech tree, covered with snow-white down. On the slightest jar of the branch, a shower of tiny drops of a water-like fluid falls from these insects. Having met with no description of the *E. fagi*, (Linn.,) or its habits, I am unable to ascertain whether that insect is dissimilar to ours. No. 864, male; 865, female (?); 866, larva.

PINE-TREE BLIGHT, **E. strobi*. Black, pubescent, subpruinose; a dorsal row of white meal-like spots on the tergum; fore wings with the costal margin, the apical and two inner basal nerves, black. Length, 0·20. Common on branches of the white pine, giving to the bark of infested trees a peculiar black appearance. Belongs to a nondescript genus, intermediate between this and *Lachnus*. No. 867, male; 868, female.

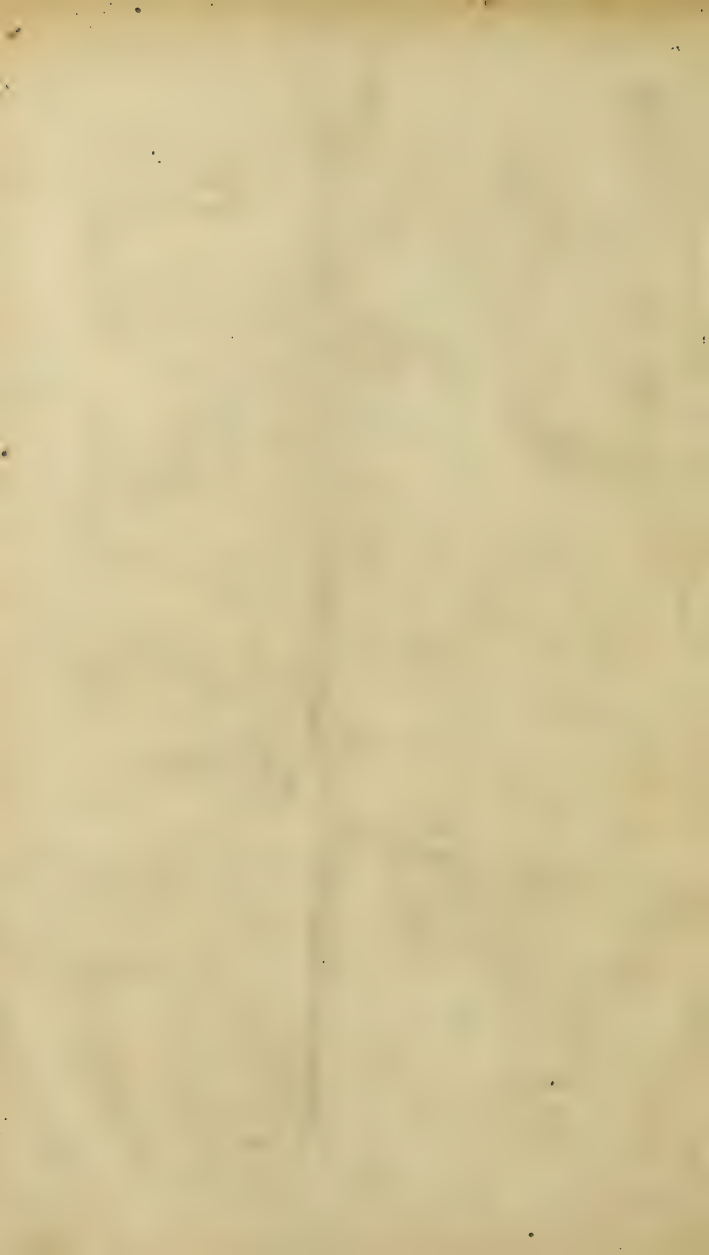
BRYSOCRYPTA. HALLIDAY,

WITCH-HAZEL BRYSOCRYPTA, **B. hamamelidis*. Males black, pruinose; wings hyaline; nerves brown; legs whitish; knees and tarsi black. Larva smaller, brown. Length, 0·09. Inhabits conical follicles on the upper surface of witch-hazel leaves; each follicle contains about a dozen individuals, and has a small orifice in the under surface of the leaf. No. 869, male; 870, larva; 871, its follicle.

FAMILY COCCIDÆ.

Our species of this family have not as yet been investigated in their living state. The dried shield-like bodies of the dead females have been met with on several of our indigenous trees. In addition to the species so abundant upon the apple-tree, and currently regarded as the *Coccus arborum-linearis* of Geoffroy, (specimen No. 872,) the following may serve as New-York examples of this family: The Willow Coccus, **C. salicis*, is ferruginous with obsolete black spots, has an oval nearly hemispheric form, and measures 0·20 in length, (No. 873.) The Linden Coccus, **C. tilia*, the largest of our species that have been observed, is ferruginous, hemispheric, and measures 0·24, (No. 874.) Both these species have the usual slit at the posterior end, and are wrinkled transversely.





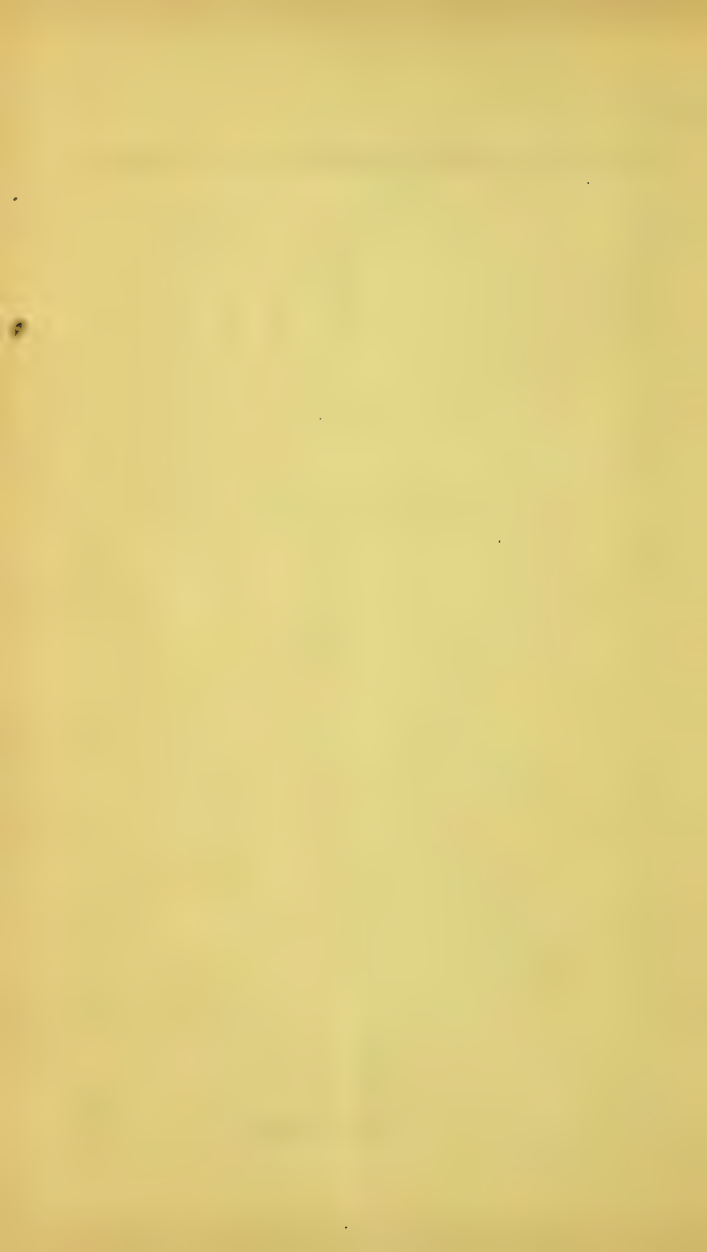
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DESCRIPTION OF THE PLATE.

- [Fig. 1. *Agrius ruficollis*, Fab. a. Its natural length.]
- Fig. 2. Hessian fly, male. (*Cecidomyia destructor*.) From a young specimen, having the fulvous sutures of the abdomen wide.
- b. Its natural size.
 - c. Ventral view of the terminal segments of its abdomen.
 - d. Joints of its antenna.
- Fig. 3. Hessian fly, female. (*C. destructor*, ♀.) From an older specimen, having the fulvous sutures narrow and in part obliterated.
- e. Joints of its antenna.
 - f. Profile view of the head, palpi, and origin of the antenna.
 - g. Dorsal view of the worm or active larva.
 - h. do do "flax seed," or larva case.
 - i. Ventral view of the same.
 - j. Lateral view of the same.
 - k. Dorsal view of the dormant larva, taken from the larva case.
 - l. Ventral view of the pupa.
 - m. Wheat stalk; sheath broken away, showing the young worms on their way to the joint.
 - n and o. Wheat stalks; sheath broken away, showing the "flax seeds" in their ordinary situation.
- A. Appearance of a healthy (*), and of a diseased (†) shoot of wheat in autumn, the worms lying at §.
- B. Appearance of a healthy (**), and two diseased stalks of wheat at harvest time. (††) Stalk broken, from being weakened by the worms. §§ Base of sheath swollen from worms having laid under it, and perforated by parasites coming from those worms.

ERRATA.

Page 5, line 17, for "*Oscinis frit* (Linn.) Lat., which infests the ears of barley" read "*Chlorops pumilionis* (Bjerkander) Meig. living in the base of the stalks of wheat and rye."

10, line 24, for "evidence" read "credence."

21, line 32, for "nor" read "and."

32, line 36, for "winged" read "wrinkled."

61, line 20, for "of" read "Of."

62, line 16, for "the" read "a."

line 26, for "sheaf" read "sheath."

THE HESSIAN FLY.

The insect which we are about to consider, has for a long period been, at times, a severe scourge, in every district of our country. It is more formidable to us, says Dr. B. S. Barton, than would be an army of twenty thousand Hessians, or of any other twenty thousand hirelings, supplied with all the implements of war. Hence it has forced itself prominently to the notice both of agriculturists and men of science. No other insect of the tens of thousands that teem in our land, has received a tithe of the attention, or been chronicled with a tithe of the voluminousness that has been assigned to this species. Our scientific journals, our agricultural magazines, and our common newspapers, have each accorded to it a conspicuous place in their columns. As may well be supposed, almost every point in its history, has by one and another of its observers, been closely investigated, and laid before the public. Very little that is new, can therefore at this day be embodied in an account of this species. The most that an observer can accomplish, is to add his testimony in confirmation of facts that have been already announced. The most that a writer can aim at, is to gather the various papers that are scattered through volumes sufficiently numerous of themselves to form a library, sift from them whatever they contain of importance, and arrange the facts thus acquired, into a connected and symmetrical memoir. Such is the object of the present essay; to carefully review the various accounts that have been hitherto published, extract from each the items of value which it contains, compare these with personal observations made under favorable circumstances during the past twelve months, and with the materials thus acquired, write out a history of this species, more ample in its details than any that has been hitherto attempted, and containing a complete summary of all that is known of this insect down to the present day.

It is a European Insect.

For several years subsequent to the first appearance of the Hessian fly in this country, it was universally believed to have been derived from abroad. When, however, the severe devastations which it was committing upon this continent became known in Europe, public attention was so strongly excited as to lead to an extensive and thorough search for the insect there. The result of this investigation, as given by Sir Joseph Banks in his report to the British government, was, that "no such insect could be found to exist in Germany or any other part of Europe." It was in consequence, received as an established fact, and assented to on all hands, that this was an exclusively American species. Of late years, however, new light has been shed upon this subject; and we now proceed to detail the evidence which induces us to believe that the Hessian fly is indeed a European insect.

It would appear that this insect, or one identical with it in its appearance and habits, did exist, and commit severe ravages in Europe, long anterior to its appearance in America. In Duhamel's *Practical Treatise of Husbandry*, (London, 1759, 4to, p. 90,) and also in his *Elements of Agriculture*, (Lond. 1764, 8vo., vol. i., p. 269,) after alluding to a worm in the root of oats, he says, "I suspect it to have been an insect of this kind that *destroyed so much wheat* in the neighborhood of Geneva, and which M. de Chateauvieux describes thus: 'Our wheat in the present month of May 1755, sustained a loss, which even that cultivated according to the new husbandry has not escaped. A number of *small white worms* have been found on it, *which*, after a time, *turn to a chesnut color*; they place themselves *betwixt the leaves* and gnaw the stalk; they are commonly found *betwixt the first joint and the root*; the stalks on which they fix are immediately at a stand; they *grow yellow and wither*. The same accident happened in 1732: these insects appeared about the middle of May, and did so much damage that the crops were scarcely worth anything.' " This account, though perhaps too brief and imperfect to justify a decided opinion, corresponds much more exactly

with the Hessian fly, than with any other insect of which we have any knowledge. Acquainted with it as our men of science in this country were, we are surprised they so readily and unanimously succumbed to the sentiment that the species was indigenous to America.

In 1788, as we are informed in the *Encyclopædia Britannica*, (art. Hessian fly, § 5,) the Duke of Dorset addressed a letter to the Royal Society of Agriculture in France, enquiring if the Hessian fly existed in that country. "The report of the society was accompanied with a drawing of two insects, one of which was supposed to be the caterpillar of the Hessian fly, from its attacking the wheat only when in the herb; beginning its ravages in autumn, reappearing in the spring, and undergoing the same metamorphoses." From an obscurity in the phraseology of the subsequent paragraph, and a reference therein to the memoirs of the Stockholm Academy, a doubt is excited, whether the society did not regard the Hessian fly as identical with the *Oscinis frit* (Linn.) Lat., which infests the ears of barley in Sweden, and consequently whether the French species was not the latter. But, as the society regarded their insect to be the Hessian fly, it is somewhat singular that its history was not investigated and distinctly recorded, before the announcement was so confidently put forth, that this species could not be found in Europe.

But, more recently, clearer evidence upon this point is furnished us. Mr. Herrick, in his valuable article in *Silliman's Journal*, (vol. xli., p. 154,) informs us, that Mr. J. D. Dana, who had been much associated with him in making a thorough investigation of the habits of the Hessian fly and its parasites, being on a voyage in the Mediterranean, "on the 13th of March, 1834, and subsequently, collected several larvæ and pupæ, from wheat plants growing in a field, on the Island of Minorca. From these pupæ, were evolved on the 16th of March, 1834, two individuals of an insect, which his recollections (aided by a drawing of the Hessian fly with which he was provided,) enabled him to pronounce to be the *Cecidomyia destructor*. More of the perfect insects were evolved in the course of the month, one of which deposited eggs

like those of the Hessian fly. In letters, dated Mahon, April 8 and 21, Mr. D. sent me five of the insects, and several of the pupæ. They arrived in safety, and after a careful examination, I saw no good reason to doubt the identity of this insect with the Hessian fly. The Mahonese asserted that the insect had been there from time immemorial, and often did great damage both there and in Spain." And further, "on the 28th of April, 1834, Mr. D. collected from a wheat field just without the walls of Toulon, in France, several pupæ and one larvæ like those before obtained. On the 4th of June, 1834, he obtained similar pupæ from a wheat field near Naples." We doubt whether there was living, at that day, two persons better qualified to determine the identity of these insects with the Hessian fly, than Messrs. Herrick and Dana. Testimony from such a source needs no comment.

Finally, the year previous to that in which Mr. Dana made the above examination, it appears that the wheat crops in some parts of Germany, were seriously injured by an insect which was generally regarded as the Hessian fly. M. Köllar, of Vienna, in his treatise on injurious insects, (London, 1840, p. 119,) relates that in the autumn of 1843, complaints were made that the wheat on the estates of his imperial highness, the Archduke Charles, at Altenburg, in Hungary, had been considerably injured by an unknown insect, of which the following account was forwarded to the archducal office. "Till the end of May the wheat was in excellent condition, but about the commencement of June, the ears began to hang down, and the stem to bend, and in a few days patches appeared in different parts of the fields which were of rather poorer soil than the others, with the plants entangled and matted together, as though lodged by heavy rains. . . . More than two-thirds of the straw was lodged in less than a week; and the heavy rains which fell in the latter half of June, so fully completed the work of destruction, that the wheat fields looked *as if herds of cattle had gone over them*. The cause of this damage was sought for, and we soon discovered at the crown of the root of each of the wheat plants, or at the first joint, within the sheath of the leaf, whole clusters of pupæ of an unknown insect. Those

plants, the roots of which had been attacked, died off; and the spot to which the insects had fastened themselves on the still soft straw within the sheath of the leaf, was found to be brown, withered, and tough, yet *without any apparent wound*. The straw which had become lodged, produced small ears, with few and imperfect grains, which ripened with difficulty, and the straw was twisted, and of a very inferior quality."

Nearly a hundred miles south-west of Saxe-Altenburgh, a similar account is simultaneously given by Baron Von Meninger, agricultural director of the Duke of Saxe-Coburg. According to his report, "In the fields of Weikendorf, and other neighboring localities, caterpillars were found which had devastated whole fields. These caterpillars had their first abode near the ground, in the first joint of the straw, where they were found in whole families, in a sort of nest. The largest were about the length of two lines. Their color was pale green, with a small black dot above. . . . The straw became dry at the first joint, and fell over or leaned on its neighbor. The upper part of the straw received its nourishment from the atmosphere alone, and the ears formed: but they continued in a sickly condition, and could only produce small, shrivelled grains. The life of the caterpillars (their duration as naked worms?) appeared to be from about twenty-four to thirty days. As the straw ripened, the insects changed their color into a brownish hue, shrivelled up, and finally disappeared."

M. Köllar, who seems to have known nothing of the American history of this insect beyond what he gathered from Mr. Say's brief account, obtained some of the diseased straw from Germany, in which, he says, "many of the brown pupæ were found. I opened the pupæ-case, and was able to determine with great probability, partly from the form of the pupæ, and partly from the unchanged caterpillar in the pupæ-case, that it must be a small fly. I only ascertained this from the minute description and drawing of the insect from Mr. Thomas Say, in a North American journal, in which a stem of wheat, with the pupæ within it, is exactly represented as I have seen our wheat.

Mr. Westwood, in a note appended to this account, says, it is perhaps questionable whether the species, of which the above details are given by M. Köllar, is identical with Say's *Cecidomyia destructor*. He even intimates a doubt whether the European species is a *Cecidomyia*, for, from all that had been observed, this genus in its pupæ state, is naked, like the other *Tipulidæ*, and not enclosed in a case. Having himself received specimens from Dr. Hammerschmidt of Vienna, and still in the straw near the roots, he found the insect "enclosed in a leathery case," on opening which, he discovered the *larva* shrivelled up and dead. Now this nice point, so particularly noted, and so strikingly showing the acuteness of discrimination possessed by that eminent naturalist, we think must dispel the last lingering doubt as to the identity of the American and European insects. As will fully appear in a subsequent part of this paper, the Hessian fly presents this singular anomaly, that its pupæ is coarctate, or enclosed in a case like those of the *other families* of dipterous insects, but *unlike* all the pupæ of the *Cecidomyians* and other *Tipulidæ* that have been hitherto observed! The very fact, therefore, which leads Mr. Westwood to suspect the European insect is not a *Cecidomyia*, all but demonstrates that *it is the Hessian fly!*

Its Introduction into America.

The existence of the Hessian fly in Europe being premised, so many circumstances conspire to render it probable that it was introduced into this country in the mode originally supposed, that scarcely a doubt can now be entertained upon this point.

When the habits and transformations of the insect itself are considered, it will be perceived that these interpose great obstacles to its being transported across the Atlantic, at a period when two months or more were required for the voyage. Its passing through two generations in a year, make its continuance in any one stage of its existence comparatively brief. The first of these generations occupies about seven months, from October to April inclusive. This generation is nurtured at the roots of the young plants, and there is no probability that any of these plants would be taken up, so that the insect could thus be conveyed away.

The second generation is nurtured in the lower joints of the straw. The worm attains maturity in May, becomes a dormant "flax seed" in June, continues in this state till August, when the fly comes out to deposit its eggs in September. Though most of these flax seeds remain in the stubble when the grain is harvested, numbers of them are so high in the straw, as to be gathered with it. But they are so firmly imbedded in the straw, and enveloped within the sheathing base of the leaf, that it must be rare that any of them are detached by the flail in threshing, so as to find their way among the grain, and thus with it be carried to a distance. As the flax seeds moreover, evolve the perfect insect in August, it must be equally rare that a solitary fly comes from the straw after that date. These facts clearly show that there is *but one mode*, and *but one month in the year*, in which this insect could probably have been conveyed to this country at that time, to wit, *in straw* landed upon our coast *in August*. If landed at a later date, the flies would have completed their transformations, and made their escape, or perished in their confinement; if earlier, there is no probability that the straw could have been of the growth of that year, consequently it would have contained no live insects. Our present knowledge of the habits of this insect thus affords us a singularly accurate test, for ascertaining the truth of the original theory respecting the mode in which it was introduced.

And how do the facts furnished us by the military history of those times, accord with what we have seen to be almost essential contingencies to the importation of this insect? Early in July of the year 1776, General Sir William Howe arrived on the New York coast from Halifax, with the troops which had evacuated Boston, and debarked upon that part of Staten Island which lies within the Narrows—one of the reasons which induced him to make this part of the continent the central point of his operations being, that "Long Island was very fertile in wheat and all other corns, and was deemed almost equal alone to the maintenance of an army." (*Bisset's Hist. Geo. III.*) We are informed in *Marshal's Life of Washington*, (vol. ii., p. 424,) under the date of *August*, 1776, that "the reinforcements to the British army

were *now* arriving daily from Europe." Lord Howe's strength was hereby augmented to twenty-four thousand men, about half of whom (as is probable from the statement, page 416,) were newly arrived "Hessians and Waldeckers." The most of these were from Hesse Cassel, a district but about a hundred miles distant from Saxe-Coburg and Saxe-Altenburg, where, as we have already seen, the same insect did much damage to the wheat crops in 1833. And again, under the date of August 25, (p. 437,) it is stated, that "*on this day*, General De Heister landed with two brigades of Hessians. The next day he took post at Flatbush," on Long Island, about six miles distant from the main encampment on Staten Island.

In juxtaposition with this account, let us now place the statement of one, who, Sir John Temple, the British Consul General at New York tells us, "had been more curious with respect to this insect, than any other person with whom he was acquainted." Says Col. Morgan, (*Encyc. Britan.*) "the Hessian fly was first introduced into America, by means of some straw made use of in package, or otherwise, landed on Long Island, at an early period of the late war; and its first appearance was in the neighborhood of Sir William Howe's detarkation, and at Flatbush." So many circumstances concur to evince the truth of the account here given by Col. Morgan, to its very letter, that we think no one will hereafter hesitate to give it full evidence.

We have searched in vain for the date of the embarkation of the Hessian troops, or the number of days occupied by them in crossing the ocean. It is possible they may all have left Europe anterior to the harvest. But in Germany, as in this country, as is shown by M. Köllar's statement, the infested straw becomes broken and tangled, and turns yellow, early in June. Had a company of soldiers needed straw for package, no objections would have been made to their going into a field of this kind, and with a scythe, gathering what they required, weeks before the usual time of harvest.

We have nowhere met with but one statement, which goes directly to prove that this insect is indigenous to this country, or existed here anterior to the arrival of the Hessian troops. The

late Judge Hlickock of Lansingburgh, N. Y., in a communication to the Board of Agriculture in the year 1823, and published in the memoirs, (vol. ii., page 169,) says, "a respectable and observing farmer of this town, Col. James Brookins, has informed me, that on his first hearing of the alarm on Long Island, in the year 1786, (doubtless, 1776 is intended,) and many years before its ravages were complained of in this part of the country, he detected the same insect, upon examining the wheat growing on his farm in his town." If this insect, observed by Col. Brookins in 1776, was the genuine *destructor*, it is a little singular that to betray its real character, it patiently awaited some fourteen years, to be reinforced by its kindred from Long Island, who reached it by regular advances made year after year—that on their arrival, and not till then, it acquired the skill and courage to go forth and lay waste the crops through all this section of country for several successive years. The strong probability is, that it was some other insect which was found by Col. Brookins.

Its Civil History and Bibliography.

We now proceed to adduce such facts as we have been able to collect, respecting the devastations of this insect in different years, or in other words, to trace out with as much precision as the data before us will enable us to do, its civil history, from the period of its first appearance, down to the present time; and in connection with this, to notice the different memoirs and other papers of value that have been published respecting it, so far as we have had an opportunity of becoming acquainted with them.

Anterior to the revolutionary war, the Hessian fly was unknown in this country. No allusion to an insect of this kind has been found in any American work, or in the journal of any foreign traveler, nor since its appearance has it been intimated that any of our citizens had ever observed it previous to that time.

All accounts concur in stating that its first appearance was upon Staten Island, and the west end of Long Island. There is some discrepancy between different writers, as to the particular year in which it was first observed. Dr. Mitchell states (*Encyc. Britan.*) that "it was first discovered in the year 1776." The ravages of

the insect, however, are so much more conspicuous and liable to attract attention from the broken and tangled condition of the straw as it approaches maturity in June, than they are when a portion of the young shoots are discolored and withered in October, that there can be little doubt but it would first be observed at the former period. Had Dr. Mitchell, therefore, received definite information upon this point, it would doubtless have been coupled with the statement, that it was noticed at or before the harvest in that year, and consequently anterior to the arrival of the Hessian troops—which fact, he, confident as he was that this was an indigenous insect, would not have failed triumphantly to have stated. It is hence believed, that Dr. M. has assumed this date, from the current report that this insect was introduced by the Hessian soldiers, knowing this to have been the year of their arrival.

From the "flax seeds" casually lodged in the imported straw, only a few flies would probably be evolved, to deposit their eggs upon the young wheat in the autumn of 1776; nor would these have multiplied to such an extent in the following spring as to attract attention at the time of harvest. But, increasing with each successive brood, by the harvest of the following year, 1778, we might anticipate its being observed, and by a year thereafter, it would become so numerous, that its real character would no longer be in doubt. And in accordance with this, we are informed by Colonel Morgan, that "the fly made its first appearance in 1778:" and Mr. Clark, who in 1787 went to Long Island expressly to gather authentic information respecting this insect, says in his report, "on the best enquiry I could make, during my stay there, I satisfied myself in the following particulars, namely; first, that the Hessian fly made its first appearance there about the year 1779, so as to injure, and in some cases to destroy their crops of wheat." An anonymous writer in *Carey's Museum*, (vol. i., p. 143,) gives the same year as about the period of its discovery.

We therefore regard the year 1779 as most probably the date when its ravages actually commenced. The crops of wheat were severely injured or wholly destroyed by it in King's and Richmond counties, during several of the following years; and each

successing generation regularly enlarged the sphere of its devastations in every direction.

Quite early in its history, the important fact became accidentally discovered, that certain varieties of wheat are capable of withstanding its attacks. In the year 1781, a prize schooner loaded with wheat, was taken in the Delaware river, and carried into New York, whence the cargo was sent to the mill of Isaac Underhill, near Flushing, Long Island, to be ground. Mr. Underhill's own crop of the previous year having been so entirely destroyed that he had no grain for seed, he took what he required for sowing from this cargo, and reaped therefrom upwards of twenty bushels per acre, whilst few of his neighbors for miles around had any to reap, so calamitous were the operations of the fly. To his praise be it recorded, he distributed his entire crop, in small quantities, and at a moderate price, among his neighbors, for seed; and all who made use of it were similarly successful. The "Underhill wheat" at once became noted, for effectually resisting the attacks of the fly, and for many years subsequently, as we shall have frequent occasion to notice, was eagerly sought for and successfully cultivated, where all other varieties of this grain failed. (*Vaux and Jacobs, Clark.*)

In 1786, the fly first reached Col. Morgan's farm, at Prospect, New Jersey, about forty miles south-west of Staten Island. It was first observed in May, and by October was so increased, that some farmers in Middlesex, Somerset, and Monmouth counties were induced to plow up their young wheat and sow the fields to rye. Other fields, less injured, were allowed to remain until the succeeding spring, when their appearance was so disheartening, that many of them were plowed up and sowed with spring grain.

Eastward its progress would appear to have been much more rapid than towards the west and south, for this same year it had reached a hundred miles, nearly to the east end of Long Island, and was detected on Shelter Island. "It was first perceived a little before the harvest, and appeared to have come from the west end of Long Island, in a gradual progress of between twenty and thirty miles in a year. Before the harvest the species appeared

to be few in number, but in the fall it was found to have greatly increased, and appeared in great numbers on the green wheat, and was observed to do most injury to that which had been most early sown." (*Havens*, p. 71.)

Public attention was now becoming strongly directed towards this formidable foe. The New York Society for Promoting Useful Knowledge, issued an advertisement, requesting information respecting it. Two communications were soon received by them, and were directed to be inserted in the secular papers. These are the first published documents relating to the fly, that have occurred to our notice. They are copied into *Carey's American Museum* (Phila. vol. i., p. 324-326). One of them, dated New York, September 1, 1786, gives a brief but pretty accurate account of the situation and habits of the insect, particularly in the fall and spring. The other, dated Hunterdon, New Jersey, January 1, 1787, after hastily alluding to its habits, proposes as remedies, late sowing, on rich land; drawing elder bushes over the young plants; and passing over the wheat with a heavy roller to crush the worms.

In the *Pennsylvania Mercury* of June 8, 1787, is published a letter from Col. George Morgan, addressed to the Philadelphia society for promoting agriculture. He suggests the importance of their appointing some competent person to fully investigate the habits of the Hessian fly, and the remedies to protect from it, after the example of the Paris Academy of Sciences, which had commissioned Messrs. Duhamel and Tillet to enquire out the history of the Angoumois grain moth; he alludes to contradictory reports respecting the Underhill wheat, copies the paragraphs already given, from M. Châteaueux, as "answering in every respect to our Hessian fly," and gives an account of the ravages of the insect in his vicinity, and its habits so far as observed.

The *Mercury* of September 14th, contains another letter from Col. Morgan, correcting some inaccuracies in his previous communication, and giving some additional interesting items. He says, "those who are doubtful whether the fly is in their neighborhood, or cannot find the eggs or nits in the wheat, may satisfy themselves by opening their windows at night, and burning a

candle in the room. The fly will enter in proportion to their numbers abroad. The first night after the commencement of the wheat harvest this season, they filled my dining room in such numbers, as to be exceedingly troublesome in the eating and drinking vessels. Without exaggeration, I may say, that a glass tumbler, from which beer had been just drank at dinner, had five hundred flies in it, within a few minutes. The windows are filled with them when they desire to make their escape. They are very distinguishable from every other fly, by their (having) horns or whiskers."

Accompanying Col. Morgan's letter is a brief report, made by Thomas Clark, who, at the request of his neighbors had gone to Long Island, to gather correct information respecting the fly, and the means of escaping its depredations. He became well satisfied that the Underhill wheat was fly proof, and could be obtained in any desired quantities, at the moderate price of \$1.25 per bushel. He also reports the interesting fact, that the fly had now become so reduced in its numbers on the west end of Long Island, that many of the inhabitants supposed there had been none the present year, though he himself saw it there quite common still. Since 1779 their crops had been destroyed more or less every year, until the present.

In 1788, a communication in *Carey's Museum* (vol. iv., p. 47), from Buck's county, Pa., informs us that in the vicinity of Trenton, N. J., so much as the seed sown would not be harvested. Many farmers had plowed up their wheat crops in the spring, and planted them with corn. The fly also in this year commenced its ravages in the state of Pennsylvania. "Near seed-time last year, many persons on the Pennsylvania shore saw the insect so thick in the air as to appear like a cloud, coming over Delaware river."

Following this communication, is a paper signed "a landholder," who regards the eggs as laid in the grains of ripe wheat, and sowed with them; and proposes procuring seed from places not infested with the fly, as a remedy.

Messrs. Vaux and Jacobs, farmers of Providence, Pa., in July, 1788, made a tour through New Jersey and Long Island, for the

purpose of gathering information respecting the fly, and the best modes of withstanding its attack. Their account is published in the *Pennsylvania Packet* of August 21st, and is mainly occupied with a description of the Underhill wheat, and a full confirmation of previous reports respecting it.

On the east part of Long Island, where, as already noticed, the fly arrived in 1786, it so rapidly multiplied, that the following year many fields were nearly destroyed, and this year, the third of its presence, the wheat crop "was cut off almost universally." The red-bald, which was the common winter variety there raised, and the spring wheat, were equally affected. Rye in many fields was much injured, and a field of summer barley was wholly destroyed. (*Havens*, p. 73.)

Wheat in large quantities, was at this period exported hence to Great Britain. Accounts of the appalling havoc that this insect was making, excited the attention of the government there, and aroused their fears, lest so dreadful a scourge should be introduced into that country, by means of the American grain. "The Privy Council sat day after day, (says *Kirby and Spence*, vol. i., p. 50,) anxiously debating what measures should be adopted to ward off the danger of a calamity more to be dreaded, as they well knew, than the plague or pestilence; expresses were sent off in all directions to the officers of the customs at the outports, respecting the examination of cargoes; despatches written to the ambassadors in France, Austria, Prussia, and America, to gain that information, of the want of which they were now so sensible; and so important was the business deemed, that the minutes of the council, and the documents collated from, fill upwards of 200 octavo pages." In consequence of the information laid before them, a proclamation was issued by his Britannic majesty, on the 25th of June, 1788, prohibiting the entry of wheat, the growth of any of the territories of the United States, into any of the ports of Great Britain. It is very singular, that although the *entry* of American wheat was thus interdicted, it was still allowed to be *stored* at the different seaports, thus affording the obnoxious insects, if any of them had been contained in the grain, a very

convenient opportunity to escape and make their way into the country!

When the news of the closing of the British ports against American wheat reached this country, the measure was at once regarded as having resulted from misinformation respecting the habits of this insect. The supreme executive council of Pennsylvania immediately addressed a letter to the Philadelphia Society for Promoting Agriculture, requesting the society to investigate and report to the council the nature of the Hessian fly, and particularly whether the quality of the grain is affected by it. The society promptly replied, "that from every communication made to them on that subject, they are decidedly of opinion that it is the plant of the wheat alone, that is injured by this destructive insect, that what grain happens to be produced from such plants, is sound and good, and that this insect is not propagated by sowing wheat which grew on fields infected with it." They also refer to the letters of Col. Morgan, and of Messrs. Vaux and Jacobs, as containing the best information extant, relative to the natural history of the insect, and the most successful method of preventing its depredations. (*Carey's Museum*, vol. iv., p. 244.)

Dr. Currie took an active part in showing the government and people of England, that the information which had led to the closing of the ports against the entry of American grain, was wholly erroneous; and in eight or ten months the government bought the stored wheat at prime cost, kiln-dried it, and resold it at great loss. The prohibition was taken off almost immediately thereafter. (*Memoir of Currie*, ii., 65.)

The Hessian fly "reached Saratoga, two hundred miles (north) from their original station, in 1789," says Dr. Harris, though on what authority is not stated. Of its correctness, however, there is no doubt. From the statements of several persons who were residing in Washington and Saratoga counties so long ago as this date, it appears that the crops in this district of country, (at that day second to no other in the quantity of wheat which it produced,) first began to fail about the year 1790 or 1791. The insect reached here by a regular progress from the south, coming nearer and nearer each successive year. It continued to infest

the crops during a number of the following years, sometimes severely, at others but moderately. On two or three occasions, many of the fields in Saratoga county were entirely destroyed. I do not learn that in this vicinity their devastations at any time reached this extent. About the year 1803, their last depredations were committed. From that time this insect has never been observed in this vicinity, that I can ascertain, until the autumn of last year.

In 1792, the recently instituted New York Society for the Promotion of Agriculture, Arts, and Manufactures, issued part first of their *Transactions*, containing (p. 71-86), "Observations on the Hessian Fly, by Jonathan N. Havens." This is the most valuable memoir that had hitherto appeared upon this subject, and few of those of a later date surpass it. After sketching the ravages of the fly in different years in his own vicinity, Judge H. describes with much precision its situation and appearance in the respective stages of its existence, showing that it passes regularly through but two generations in a year, instead of three or four, as anterior writers had stated. As remedies, he recommends sowing none but the bearded wheats, and burning or plowing up the stubble soon after harvest. This last important measure had never before been proposed; Judge H. had been led directly to it, by his close investigations of the habits of this insect.

The American Philosophical Society this year appointed from among its most competent members, a committee (Thomas Jefferson, B. Smith Barton, James Hutchinson, and Casper Wistar), "for the purpose of collecting and communicating to the society materials for forming the natural history of the Hessian fly." This committee immediately issued a circular, requesting all persons acquainted with any facts relating to this insect, its depredations, and preventives, to communicate the same by letter to their chairman. The numerous points upon which information was desired, were particularly detailed in an extended series of questions, which clearly indicate the importance which they attached to this subject, and the thorough investigation which they purposed making. It cannot but be regretted that this business, committed to such capable hands, was not pursued and brought to a close

with the same zeal with which it was evidently commenced. We have met with no report ever rendered by them. (*Carey's Museum*, vol. xi., p. 285.)

At this time, as we infer from a clause in the circular just alluded to, and also from some passages in Dr. Mitchell's address before the New York society of agriculture; (*Transactions*, vol. i., p. 32,) the insect was becoming so rare in all the more densely settled parts of the middle states, which had been first overspread by it, that it was the common opinion that it would soon vanish from the country entirely. Notices of it in the magazines and newspapers become more rare, and it was evidently ceasing to be regarded with that intense solicitude which it had hitherto excited. It was, however, with unabated vigor, continuing its progress southward. A letter from Prospect Hill, Delaware, dated June 12th, 1792, (*Carey's Museum*, vol. xi., p. 301,) states that the fly arrived there "in prodigious clouds," about the middle of the preceding September. It describes the place where the eggs were deposited on the young wheat, the growth of the worm, and the perishing of all the plants, except those growing upon a rich soil, and adds further testimony in favor of the Underhill wheat.

In 1797, Dr. Isaac Chapman, of Bucks county, Pa., prepared one of the best accounts of this species that has ever appeared, containing the details of his own careful observations upon the insect and the time of its appearance in its different stages. These observations lead him to recommend as the most certain safeguards against the fall attack, late sowing, and against the spring attack, a quick vigorous growth, to be obtained by procuring southern seed and sowing it on a rich, elevated and dry soil. His paper is published in the fifth volume of the *Memoirs of the Philadelphia Society for Promoting Agriculture*, a volume which we regret having been unable to find in either of the largest libraries of this state. We are therefore obliged to depend for its contents upon second hand accounts. Dr. C. states that the fly was this year found upon the west side of the Alleghany mountains.

The eighth volume of the *Encyclopedia Britannica*, published this year, gives (pages 489-495) an extended article under the head *Hessian Fly*, consisting chiefly of a summary of the several

documents laid before the privy council during their investigations.

In Dr. B. S. Barton's *Fragments of the Natural History of Pennsylvania*, issued in 1799, the author announces (p. 23) his intention of publishing "a memoir upon that destructive insect called the Hessian fly." It is probable that whatever communications were addressed to the committee of the Philosophical society, had been consigned to his hands. We are not aware that the promised memoir ever appeared.

"About the year 1801, the Hessian flies first made their appearance in the neighborhood of the city of Richmond. We saw but little mischief that year. But in 1802 they were much more destructive—1803, they swept whole fields—about the same in 1804." (*H. McClelland, Amer. Farmer*, vol. ii. p. 234.)

In the year 1803, we arrive at the first notice of this species, of a scientific nature. Dr. Mitchell, in a short article in the *Medical Repository* (vol. vii., p. 97, 98), entitled "Further ravages of the wheat insect, or *Tipula tritici* of America, and of another species of *Tipula* in Europe," states that it is now understood that our insect is a *Tipula*. He alludes to the extent of this genus, (ninety-four species being enumerated by Weber,) and though he has often examined our insect, and bred it so as to observe its transformations, he declines giving a decided opinion whether or not our species is different from all those that had been described. He refers to the species "treated as a non-descript" by the Rev. Mr. Kirby, in the *Linnean Transactions*, copies its name and technical characters, and closes with the remark, that whether Mr. Kirby's insect is a new one or not, it is not the same animal which has been so injurious in this country. Had the doctor but added a few words descriptive of our species, he would undoubtedly be entitled to "the barren honors of a synonym." Respecting the depredations of the insect at this time, we learn from him, that "during the cold and dry spring of 1803 these creatures again infested the wheat more than they had done for many years. Many crops were cut off early in June, and the ground plowed up for other purposes."

During a long interval we meet with no further notices of this species. Its depredations would appear to have been so slight, and public attention was so much engrossed with other affairs, that nothing, as we have discovered, is recorded of it.

At length, in 1817, it is stated to have renewed its ravages in various sections of the country. In the neighborhood of New York and of Philadelphia, it is evident that it was unusually abundant, and in parts of Maryland and Virginia, it was perhaps more destructive than it had ever been before.

It was on the 24th of June in this year, that Mr. Say read before the Philadelphia Academy of Natural Sciences a paper entitled "Some account of the insect known by the name of Hessian fly, and of a parasitic insect that feeds on it." This contains an accurate technical description of the insect, on which he bestows the name *Cecidomyia destructor*, and also of its most common parasite, referred by him to the genus *Ceraphron*, and also named *destructor*. This paper was published in the *Journal of the Academy* (vol. i., p. 45-48), issued in the course of the ensuing month, and was followed in August by a copperplate illustration of these insects, drawn and engraved by Mr. C. A. Le Sueur. "A local habitation and a name" were thus conferred upon this world-renowned species, by which it has ever since been definitely specified and arranged in works of science.

In the *American Monthly Magazine and Critical Review* for August, 1817, (New York, vol i., p. 275-279,) appeared a paper bearing the title, "An account of the wheat insect of America, or the *Tipula vaginalis tritici*, commonly called the Hessian fly." This paper gives the substance of Judge Havens's memoir, and professes to copy a technical name and description which had been published by Dr. Mitchell in the *New York Gazette* of July 3d. But whoever refers to the *New York Gazette*, will find no attempt at a technical description, nor no name except that of *Tipula tritici*, which is in one instance, casually as it were, made use of. The word *vaginalis* is therefore an interpolation of the writer in the *Magazine*; and as he, at least on some subsequent occasions, refrained from bringing this name farther into notice,

when a fair opportunity was presented him for doing so (as editor of *Hooper's Medical Dictionary*, &c.) we doubt not, when the excitement of the day was past, he deeply regretted that he had ever drawn up an article so derogatory to himself as that which appears in the *Magazine*. We should therefore suppress all allusion to this subject, with the hope that it might pass wholly into oblivion, but that the article from the *Magazine* has of late years been copied into some of our agricultural journals, and has been referred to in terms of commendation by some names of respectability. With the currency thus unfortunately given to it, it will be read by hundreds who can never see the *New York Gazette*, and who will thus deem that one of our most distinguished savans had degraded himself by a paltry attempt to forestall Mr. Say in giving to this species a technical name.

Gen. John H. Cocke this year communicated his observations to the Albemarle Agricultural Society of Virginia. Having well ascertained that the fly deposits its eggs upon the blades of the wheat, at from a half to three inches from the central stalk, and that these remain there four or five days before they hatch, he recommends feeding off the crop, by pasturing sheep upon it; thus destroying the eggs, and depriving the fly of its wonted place for depositing them. "A King William Farmer" dissents from this advice, and thinks covering the seed to the depth of three inches the best safeguard against the fly. "A Frederick County Farmer" and Dr. Merriwether oppose this, and a controversy ensues, reaching through several communications in the *Richmond Enquirer* and *National Intelligencer*, and afterwards continued in the *American Farmer*, till in 1820 it was brought to a close by a valuable article from that distinguished agriculturist, the late James M. Garnett, (*American Farmer*, vol. ii., p. 174,) accompanied by an illustration, clearly demonstrating the correctness of the statements first put forth by the King William Farmer. The facts thus elicited will be more fully considered in a subsequent part of this essay.

In 1820, Edward Tilghman, of Maryland, described (*American Farmer*, ii., 235) the place and mode of deposition of the eggs,

he having in numerous instances watched the fly in the very act of ovipositing. At a later day Mr. T. has favored the public with a more full and exact description of this process. (*Cultivator*, viii., p. 82.) James Worth of Pennsylvania, also in 1820 minutely described from his personal observations, the situation of the egg, its hatching, and the journey of the worm down the leaf to its usual nidus. (*American Farmer*, ii., 180.)

In the second volume of the *Memoirs of the New York Board of Agriculture*, issued in 1823, is a communication (p. 169-171) on the Hessian fly, from Judge Hickock, who deems a fertile soil the best safeguard. In the third volume of the same work, published in 1826, (p. 326-338,) is a paper by the indefatigable secretary of the board, the late Judge Buel, giving a condensed summary of all the information respecting this insect, contained in the accounts of Judge Havens, Dr. Chapman, and the different writers in the *American Farmer*.

In 1840, Miss Margaretta H. Morris, of Germantown, Pa., in a communication to the American Philosophical Society, revives the theory of "a landholder," already noticed, that the egg of the fly is deposited in the grain, and that obtaining seed from uninfected districts will therefore be the best safeguard. The report of the committee upon this paper, is inserted in the society's *proceedings* of November, 1840, and the paper itself is published in the society's *Transactions* (vol. viii., p. 49-51). Communications bearing upon the same subject were also made to the Academy of Natural Sciences, in 1841, by Dr. B. H. Coates. (*Proceedings Acad.*, vol. i., p. 45, 54 and 57.)

In 1841, Mr. E. C. Herrick, librarian of Yale College, gives "a brief, preliminary account of the Hessian fly, and its parasites," in *Silliman's Journal of Science* (vol. xli., p. 153-158). This paper announces the interesting fact of Mr. Dana's having met with apparently the same insect on the shores of the Mediterranean, details the writer's own accurate observations of the changes from the egg to the flax seed state, and enumerates four different parasitic insects that prey upon it during these periods of its existence, by which "probably more than nine-tenths of every generation of

the Hessian fly is destroyed." Another valuable paper from Mr. Herrick appears in the *report of the Commissioner of Patents* for the year 1844, (p. 161-167,) giving a most exact and particular history of the transformations of this insect, and a summary view of the various remedial measures that have been proposed. Both of these papers evince the close and patient investigation which the writer had made, and the utmost carefulness in announcing nothing beyond what he had clearly ascertained.

Dr. T. W. Harris's invaluable "report on the insects of Massachusetts injurious to vegetation" was also completed in 1841. An excellent summary of all the leading facts pertaining to the history of this species, is given in this work (p. 421-433,) and its generic place, upon which point Mr. Herrick, Latreille and others had intimated doubts, is correctly settled.

The numerous agricultural periodicals of our country, abound with notices of this insect, more or less extended and valuable. To specify these notices in detail, at least as respects some of these periodicals, would require a reference to almost every number issued. Wherever important facts are derived from these sources, in the course of this essay, they are accompanied by a particular acknowledgement in each instance: an additional reference in this place, is therefore deemed unnecessary.

We close this section of our subject, with a condensed view of the depredations of this insect in the different parts of our country, during a few of the past years; the materials for which, are furnished us, in those valuable documents, the yearly reports of the Commissioner of Patents.

In the year 1842, the ravages of the Hessian fly would appear to have been quite limited. Pennsylvania suffered the most severely. The wheat crop in this state is estimated to have been twenty per cent less than it was the preceding year, and of four different causes that produced this diminution, the fly is placed first. Some parts of Maryland, and also of Ohio, were visited by it. In the latter state, it appeared to be increasing so much, that serious apprehensions were beginning to be felt respecting its future ravages.

In 1843, it was so abundant in western Pennsylvania in June, that it was thought it would diminish the crop twenty-five per cent. Through Maryland, and the great wheat-growing valley of Virginia, it was noticed at the same time as committing great havoc in many fields, and threatening a very decided failure in the crop: at harvest, however, the yield was found to be much better than was anticipated. In Ohio it was less injurious than in the preceding year. Upon some parts of Long Island it was observed, but in limited numbers.

In 1844 it seems to have been much more destructive than in either of the preceding years, and to have made its appearance prominently in some districts where it had been unobserved before. Thus, through all the northern parts of Indiana and Illinois, and the contiguous parts of Michigan and Wisconsin, it did much injury, and in many places occasioned almost a total failure of the crops. Near Goshen, Ia., a person writes, the fly is taking the wheat here at a dreadful rate, destroying some pieces entirely: some fields have been plowed up, and corn planted therein. The *Prairie Farmer* states that the wheat crop has suffered severely in various sections by the fly. In Will county, Ill., says the *Chicago Journal*, several entire fields of both winter and spring wheat have been destroyed by the Hessian fly. In Michigan also, it is reported to have made sad havoc, particularly in light sandy soils. From different places in this state, we are told as follows: "In some cases the injury was so severe, that the farmers had to plow up their fields and sow them over again." "There is not more than one-fourth of the surplus of 1843, owing to the wet season and the ravages of the fly." "The wheat crop is almost an entire failure. The insects took it last fall, and the rust in the spring, and then again the insects a second time." It is also stated that the same enemy had made its appearance in great force at the close of the season, in the early fall sown wheat. From different parts of Ohio, the crop was reported in May and June to be suffering considerably from the ravages of the fly. In the vicinity of Masillon it had never been so destructive before, whole fields being entirely destroyed. In the neighborhood of Rochester, N.

Y., also, the fields suffered some, particularly those having a sandy soil, and that were early sown. On the west end of Long Island, its ravages were also bad, many farmers not having more than half a crop. Both in the eastern and western sections of Pennsylvania, the fly lessened the produce of this year. In Bucks county it was particularly destructive. One person states, in the month of June, that where he had expected to gather 1,200 bushels or more, he could not now hope for 300. Though it is noticed on both shores of the state of Maryland, the injury done by it here appears to have been but slight.

In 1845, through those districts of Michigan, Indiana, and Illinois, where it committed such havoc the last year, it is said by different persons to have wholly disappeared. The *Prairie Farmer* however, states that it was still present, doing more or less injury all over the state of Illinois. Ohio sustained but little injury. It is not noticed north of Maryland, in the central parts of which state it is reported that on nearly all the light lands the Hessian fly made serious ravages, and in many instances rendered the crops totally worthless. In Georgia, moreover, its ravages in the counties around Milledgeville are said to have been dreadful: whole fields were totally destroyed, and others yielded not more than a fourth of an ordinary crop.

We regret that we have not at hand the requisite information, for tracing with equal precision the ravages of this insect during the present year. From such notices as we have casually observed in the public papers, we presume that through the country generally, it has been unusually numerous. In this vicinity, some fields have produced less than a fourth of what they would have done, but for the invasion of the fly last autumn, after an absence of over forty years, and its great increase in the spring. On sandy soils in Saratoga and the north-west parts of Rensselaer counties, several fields were observed early in July with the wheat stalks so "few and far between," that no harvesting of them would be attempted; whilst many others had been, at an earlier period of the season, plowed up and occupied with spring crops. In the western section of the state, it has also been quite destructive. The loss

from the fly alone, says the *Genesee Farmer*, (vol. vii., p. 251,) will doubtless be at least 500,000 bushels. In those districts of Illinois, Wisconsin, and Iowa, which are contiguous to the Mississippi river, it appears to have been common, and also in eastern Pennsylvania. From a minute in the proceedings of the trustees of the Maryland Agricultural Society, we learn that "so great ravages have not been committed by the Hessian fly, since 1817. On some of the best land wheat has been plowed up, and other portions are so much injured, that they will not be worth harvesting. At least one-half of the crop of Talbot county has been destroyed." And in the upper counties of Georgia, it is said, "the fly has committed such ravages upon the wheat, as scarcely to leave enough seed for another year."

Its Name and Synonyms.

It is a somewhat trite but very true adage, that "names are things." Every one who has had occasion to search through files of our agricultural journals for information respecting any particular insect or other malady to which our crops or herds are subject, well knows what doubt and perplexity is often occasioned from having two or more names used by different writers for the same thing, and also from having two or more distinct things designated by the same name. To illustrate this, let us refer to the *Patent Office Report* for 1844, p. 26, where, in thirteen consecutive lines, we read as follows: "Near Onondaga county the wheat is said to be injured by the *grain worm*. . . . In Schoharie we find complaints of the *weevil*. . . . In Schenectady county the ravages of the *fly* were great. . . . In parts of Columbia county it suffered from the *maggot*. . . . In Dutchess a yellow *worm in the head* destroyed it." Of a truth, "what a host of enemies!" By way of climax, we only require some wiseacre who has never seen the insect or lived within a hundred miles of it, to say, "Good people, you are all wrong; *wheat worms* is the correct name for your insect"—and we are furnished with a tolerably complete list of the popular synonyms of the *Cecidomyia tritici*! But who, not intimately conversant with its American

history, would suspect this single species of being designated by such a profusion of terms. Who, on reading the page referred to, of the *Patent Office Report*, (and it is a correct transcript of the very words which are in popular use,) but would receive its statements as conclusive evidence that we had in eastern New York at least four or five kinds of destructive insects preying upon our wheat crops. Such mistakes are the inevitable results of a diversity of names. So important therefore do we deem this topic, that we are induced to assign to it a distinct head.

It is very fortunate that no confusion of the kind just alluded to, has ever existed with reference to the species under consideration. Its popular name, *Hessian fly*, was first bestowed upon it by Colonel Morgan, soon after its appearance on Long Island. Some two or three of the earliest writers allude to it by the names of *Hessian bug*, and *Hessian insect*, but these designations were speedily dropped, and *Hessian fly* became universally the only name by which it was definitely distinguished, not only in this country, but in all parts of the world where the English language was spoken. Even when it was by every one deemed to be a native insect, and the epithet *Hessian* was therefore remarked by different writers as most inappropriate, still it was in such universal use, that no one had the presumption to propose a different name. Certainly, then, at the present day, when scarcely a doubt can be entertained but that it is a *Hessian* species, any attempt to foist upon it a new popular name, must prove signally unsuccessful.

But, Mr. M. B. Batcham, editor of the *Genesee Farmer* in 1843, and subsequently of the *Ohio Cultivator*, bestows upon this species the name of "wheat-fly."^{*} If love of novelty, or fondness for innovation, prompted this gentleman to discard a name which all the rest of the world had concurred in, he could not possibly

^{*} We have been informed, by different persons, who are or have been residents of western New York and Ohio, that in familiar conversation in those districts, the species under consideration is alluded to simply as "the fly." If any epithet is prefixed to this, it is always the word "*Hessian*;" they recollect in no instance to have heard it called the "wheat-fly."

have been more unfortunate in his selection of a new one — the name *wheat-fly* having been at least fourteen years previously appropriated to a different insect, by Messrs. Loudon, Gorrie, Shirreff, and several other writers in the British periodicals; having been used by the compilers of popular treatises on insects, one of which, republished in this country, has been for several years past circulating in almost every school district of this state (*Harper's Family and School Library*, Insects, vol. ii., p. 226–228); and having, moreover, been adopted for the same insect in this country, to omit names of less note, by Dr. Harris, in his *Report* — a work so superior to any similar treatise that has ever appeared, and embodying such a large amount of most valuable information upon the injurious insects of this country, that it must long remain a standard authority upon all matters of this kind.* With such wide currency to the name *wheat-fly*, what must community think the extent of the reading of that man to be, who adventures to proclaim that this name belongs to the *Cecidomyia destructor*, nor to the *Cecidomyia tritici*! It could scarcely excite more surprise if he was to inform us that his orthography of the specific name *tritica* was correct, and that we were wrong in writing it *tritici*.

Mr. B.'s successor in the editorial chair of the *Genesee Farmer*,

* We may here state some additional reasons which induced us in our former essay, to adopt the name "*wheat-fly*" in preference to that of "*wheat-midge*," the name by which the *C. tritici* has been designated by Mr. Curtis and some other recent writers.

1. The insect itself, is, next after the wholly inappropriate name of "*weevil*," most commonly called "*the fly*," we believe, in all those districts where it is most abundant and has been longest known. It is never called "*the midge*." Why, then, should we speak one common name, and write another; or have in print as the common name, what we well know is *not* the common name:

2. No other insect in the world has a trivial name better established than the Hessian fly. Both it and the *C. tritici* will undoubtedly continue to be common insects in this country, and very frequently spoken of. If one is called the Hessian fly, and the other the wheat-midge, every person not well acquainted with this subject, will imbibe the idea that they are very different insects, their names being so dissimilar; whereas, they are most closely allied to each other.

3. It has often been remarked as a great desideratum, that the technical and common names of species in natural history, should correspond with each

we perceive is partially inclined to "follow in the footsteps—" &c. In his volume of the present year, (p. 152,) the subjoined paragraph occurs. "In the *Farmer's Dictionary*, it is recommended "to seed early," as a preventive against injury from the wheat-fly." Far be it from us to accuse our esteemed friend of misquoting his author. But if he will look again into the work alluded to, he will read under the title, "*wheat midge or fly*," that "early or late sowing will do little towards saving a crop;" whilst under the name "*Hessian fly*," occurs the unquestionably bad advice to "sow early."

The scientific name, *Cecidomyia destructor*, bestowed upon this species by Mr. Say, is the only one belonging to it, neither the name *Tipula tritici*, nor *Tipula vaginalis tritici* having any legitimate claims to be retained as synonyms. Mr. Say's name might at first view be thought liable to criticism, as being in no wise distinctive, many other species of Cecidomyians being also *destroyers*. Yet this species is so preëminent in that particular, as to throw the injuries inflicted by each of the others quite in the back ground. We hence think it will be conceded that the name is signally appropriate. Placed beside it, all its kindred are mere depredators—this alone is *THE destroyer*.

Its Characters, Transformations, and Habits.

As a general rule, the Hessian fly passes regularly through two generations annually. The first of these occupies the autumn, winter, and fore part of the spring, and is reared at the roots of the young grain, slightly below the surface of the ground. The

other; or, in other words, that the common names should in all cases where practicable, be translations of the technical names. *Cecidomyia tritici*, literally rendered in English, is *gall-fly of the wheat*; but inasmuch as this species does not produce galls, there is an obvious impropriety in retaining that word. *Wheat-fly* thus becomes the most direct translation of the technical name, that the habits of the insect admit of. No one will maintain that *wheat-midge* is a translation.

But, inasmuch as the name *fly* is bestowed upon such a vast host of insects, of different families, and even different orders, we by no means disapprove of the attempt of recent English writers to bring the word *midge* into current use, as a generic or family term for all the minute species of Tipulidæ.

second occupies the remainder of the spring and the summer, and is chiefly nurtured at the first and second joints of the straw. The time when its several transformations occur, is not perfectly uniform, being varied by the climate, the state of the weather, and perhaps other contingencies; and it is not improbable that individual specimens, placed in circumstances unfavorable to their developement, have their growth retarded so much as to require even a whole year to complete their metamorphoses.

First Generation.

THE EGG. *When and where deposited.*—The eggs of the first generation are deposited chiefly in the fore part of September. Dr. Chapman says the deposit is made from the latter end of August till the 20th of September, and most other accounts coincide with this, though some extend the time into October. On the 8th of October the fly was seen ovipositing in eastern Pennsylvania, in 1819, and it had wholly disappeared on the 11th. (*Amer. Farmer*, ii., 180.) The deposit is doubtless made later, at the south, than in this vicinity. Mr. Tilghman's description of this process (*Cultivator*, viii., 82,) will convey so much more distinct a view to the general reader, than any other that has ever been published that we here insert it. He says, "By the second week of October, the first sown wheat being well up, and having generally put forth its second and third blades, I resorted to my field to endeavor to satisfy myself by ocular demonstration, if I could do so, whether the fly did deposit the egg on the blades of the growing plant. Selecting what I deemed to be a favorable spot to make my observation, I placed myself in position, by reclining in a furrow between two wheat lands. It was a fine, warm, calm forenoon; and I had been on the watch but a minute or two, before I discovered a number of small black flies, alighting and setting on the wheat plants around me; and so strong seemed to be their predilection for the wheat, that I did not observe a single fly to settle on any grass, or any thing within my view, but the wheat. I could distinctly see their bodies in motion when settled on the leaves or blades of the wheat, and presently one alighted and set-

tled on the ridged surface of a blade completely within my reach and distinct observation. She immediately commenced disburthening her apparently well stored abdomen, by depositing her eggs in the longitudinal cavity between the little ridges of the blade. I could distinctly see the eggs ejected from a kind of tube or sting, or by the elongation of the body; the action of the insect in making the deposit, being similar to that of the wasp in stinging. After she had deposited, as I supposed, some eight or ten eggs, I easily caught her, upon the blade, between my finger and thumb. . . . After that, I continued my observations on the flies, caught several similarly occupied, and could see the eggs uniformly placed in the longitudinal cavities of the blades of the wheat; their appearance being that of minute reddish specks.

Its appearance and characters.—The account of the eggs, and also of the worms of the Hessian fly, as given by Mr. Herrick, is drawn up with such scrupulous care, and is so full and definite in every particular, that we are constrained to enhance the value of this essay by presenting it entire. He says, "The eggs are laid in the long creases or furrows of the upper surface of the leaves of the young wheat plant. While depositing her eggs, the insect stands with her head towards the point or extremity of the leaf, and at various distances between the point and where the leaf joins and surrounds the stalk. The number found on a single leaf, varies from a single egg up to thirty, or even more. The egg is about a fiftieth of an inch long, cylindrical, rounded at the ends, glossy and translucent, of a pale red color, becoming, in a few hours, irregularly spotted with deeper red. Between its exclusion and its hatching, these red spots are continually changing in number, size, and position; and sometimes nearly all disappear. A little while before hatching, two lateral rows of opaque white spots, about ten in number, can be seen in each egg. In four days, more or less, according to the weather, the egg is hatched."

THE LARVA. *Growth of the worm, or active larva.*—Mr. Herrick's excellent description is continued as follows, "The little winged maggot, or larva, creeps out of the delicate membranous

egg skin, crawls down the leaf, enters the sheath, and proceeds along the stalk, (see fig. *m*,) usually as far as the next joint below," (fig. B. $\S\S$,) or, in other words, *to the base of the sheath*, which in the young autumnal wheat, is at the crown of the root (fig. A. \S). "Here it fastens, lengthwise, (fig. *n* and *o*,) and head downwards, to the tender stalk, and lives upon the sap. It does not gnaw the stalk, nor does it enter the central cavity thereof; but, as the larva increases in size, it gradually becomes embedded in the substance of the stalk. After taking its station, the larva moves no more, gradually loses its reddish color, and wrinkled appearance, becomes plump and torpid, is at first semi-translucent, and then more and more clouded with internal white spots; and when near maturity, the middle of the intestinal parts is of a greenish color. In five or six weeks (varying with the season,) the larva begins to turn brown, and soon becomes of a bright chestnut color, bearing some resemblance to a flax-seed," &c.

Its characters.—When freshly taken from the root of the wheat the mature worm (fig. *g*.) measures about fifteen hundredths of an inch (0.15) in length, by about 0.06 in breadth. It shows no signs of life when placed upon paper and turned over with a needle-point. It is soft, glabrous, shining, white, oval and apparently composed of but nine segments, although twelve can often be distinctly perceived before its growth is completed. These are quite slightly marked by faint transverse lines of a greenish-brown hue. Its under side is flattened, and has an oblong grass-green cloud or spot in the middle, placed longitudinally. No regular contractions or crenatures occur along the margin to mark the segments, though after the worm has laid exposed to the air an hour, the color of the transverse lines above spoken of becomes bleached out as it were, and then, perhaps from the worm's having become somewhat dried, faintly impressed transverse lines are perceptible at the junction of each of the nine segments: faint longitudinal striæ are also discernable, as though produced by the pressure of the parallel veins or ribs of the sheath and culm, between which the worm had laid.

Its mode of feeding. We have hitherto sought in vain to ascertain, by ocular and microscopic examinations, how it is that the worm imbibes its nourishment from the stalk. To expose it to view, we are obliged to place it in circumstances so unnatural to it, that it apparently refrains from feeding. That it "gnaws" the stalk, as some writers in our agricultural papers, and some compilers of popular treatises inform their readers, is an error so gross as scarcely to deserve notice. Some have supposed that it absorbs its nourishment through the pores of its skin; but we incline to the belief that Dr. Lee's opinion is nearest the truth of any that has been hitherto advanced—that it takes in its nourishment by suction, in a manner more analogous to the leech than any other familiar object. (*Gen. Farmer*, vii. 225.)

Its effects upon the crop. The autumnal attack of the fly is in a double sense a *radical* one. Each particular shoot at whose root one or more of these larvæ nestles, is commonly destroyed by the time the worm has attained its growth. The presence of these worms is therefore readily detected by an examination of the young wheat in October or November. Individual shoots will be found here and there in the field, withered and changed to a light yellow color, (fig. A†.) strongly contrasting with the rich green of the vigorous uninjured plants. (fig. A*.) The frost or some other casualty may cause the ends of some of the other leaves to be of a pale yellow color, but here the whole plant is of that hue; and where a field is badly infested this yellow "sickly" aspect is perceptible from a distance. On examining the withered plants, the worm, or flax seed if it has advanced to that stage, can be readily found. It is situated a short distance below the surface of the earth, at the crown of the root (fig. A§). One or two radical leaves start from this point, their bases forming a cylindrical sheath around the central or main shoot, which as yet is but in its infancy. It is within this sheath, at its base, that the worms repose, one, two, three, or more, and by imbibing the nutritious juices of the young shoot, cause it to wither and die. The mechanical pressure of the larvæ, so frequently spoken of as impeding the circulation of the fluids of the plant, and hereby causing it to perish,

I think has had too much importance assigned to it, the young plants being so soft and pliant that they would readily accommodate themselves to this pressure, if they received no molestation beyond this.

Is the crop ever benefitted by it? The vigor and luxuriance of the uninjured shoots from the same root, contrasts so strongly with the wilted and feeble appearance of those attacked by the worm, as to have led some to believe that the unaffected shoots were stimulated to a more rapid and robust growth in consequence of the *pruning* given by the fly; and that a better crop is thus sometimes produced, by the presence of a moderate number of these worms among the wheat plants. The correctness of this opinion we very much doubt. The worm is nourished and reared upon those very fluids that are absorbed by the plant and elaborated for its own sustenance and growth. Every particle of this nutritious juice, therefore, that is consumed by the worm, is a direct loss of just so much material that would otherwise become straw and grain. At all events, we think our farmers generally will prefer that nature should be left to her own undisturbed course in rearing their wheat plants, and will be by no means solicitous to have this renowned guest take any part in the operation.

Its change to a "flax-seed" or dormant larva. When the worm, or active larva, has fully completed its growth, a slight diminution in the dimensions of the inner soft parts of its body commences, in which the outer and harder skin does not participate, this latter retaining its original full size. The result of this contraction is, that the worm gradually cleaves from its outer skin. If examined with a microscope when this change has recently commenced, a slight translucent space is observable at the head end, and a larger and more obvious one at the pointed or tail end, plainly indicating that the enclosed worm does not entirely fill its outer skin. This contraction continues, until the worm becomes entirely separated from its outer skin, and lies within it like the finger within a glove. The outer skin at the same time changes in color. From its original whiteness and transparency, it gradually becomes opaque, brown, and finally of a dark bay or chestnut

color. Though *much less flat* than a flax seed, its resemblance in color, size and form to that familiar object, is so striking as at once to be remarked by every one.

Characters of the flax seed, or larva case. Different specimens of these flax seed like larva cases (fig. *h. i. j.*) vary in length from 0.13 to 0.19 and in breadth from 0.05 to 0.08. They are shining, cylindrical-oval, more obtusely rounded at the lower or head end than at the other, which is generally attenuated into an acuminate point or small projecting papilla. They are commonly composed of but nine obvious segments, and these are but slightly indicated by very faint acutely impressed transverse striae—a similar transverse stria, but still more faint, being sometimes perceptible (fig. *h.*) across the middle of some of the segments. Longitudinal impressed striae are sometimes present, (fig. *j.*) more conspicuous than the transverse, and reaching a part or the whole length of the worm; and between these the surface is minutely acuducted (i. e. appearing as if lightly scratched by the fine point of a needle) longitudinally—all these longitudinal impressions being perhaps caused by the pressure of the veins and fibres of the plant, against which the worm has been imbedded. On the under side, (fig. *i.*) towards the head end, the case is flattened, as if pinched together, so much so that the anterior segment seems a mere empty fold of the membrane, without any inflation sufficient to make room for internal viscera. At this end is often observable one or two little brush-like granules, resembling those on the soles of the feet of some carabidous insects. (One of these is indicated on the anterior edge of fig. *i.*) Are these the relicts of the suctorial mouth of the larva? This larva case is comparatively tough and leather-like at first, but becomes more brittle and also darker with age.

Character of the dormant larva. On carefully opening the larva case just described, a worm (fig. *k.*) is found within it, scarcely different in any respect from what it was immediately before entering upon this flax seed state. It has the same oval form, opake milk-white color, and green, cloud-like visceral spot or line beneath. The nine segments into which it appears divid-

ed, however, are now much more distinctly marked than they previously were, the transverse lines being more deeply impressed, and the margins showing corresponding crenatures. No traces of the members of the future fly are yet discernible. The insect now undergoes no further change, for a period of five months or more. Enveloped in its flax seed like mantle, and reposing at the root of the now lifeless grain, it is buried beneath the snows of winter. Over one half of its entire term of life is therefore passed in this state.

Error in previous accounts. This is the stage of this insect, which has been spoken of by all preceding writers as its pupa or chrysalis state. Upon a close observation of the *Cecidomyia tritici*, the writer succeeded in discovering that that species had, what some had conjectured, but none had actually observed, a regular pupa form, identical with that of other species of *Cecidomyia*, whose metamorphoses had been fully described. It hence appeared necessary to distinctly mark that long period of inactivity which intervenes in the wheat fly, after the larva has completed its growth, and before it enters its pupa state; it was therefore, during this state of its life denominated a dormant larva, in my essay upon that species. It occurred to me whilst writing out that essay, that the dormant larva state of the wheat fly, was exactly analagous to the flax seed state of the Hessian fly, and in a note, my suspicions were expressed that the real pupa of the Hessian fly had never been detected. The ample opportunities which I have since enjoyed for investigating this species, have enabled me fully to trace out this point in its transformations, and to show that it is not till near the close of its flax-seed period of existence that the Hessian fly puts on its pupa form. In penning the note just alluded to, I had overlooked a passage in Mr. Herrick's last paper, from which it is obvious that he has seen the real pupa of the Hessian fly, although he still speaks of its pupa state as commencing when the worm becomes a flax seed. Inaccuracies of this kind, which to the general reader appear so trivial as scarcely to require correcting, are liable to lead to important errors. Of this, we have a striking illustration in this very instance. Mr.

Westwood, on opening the flax seeds contained in the wheat straw from Germany, came upon "the larva," where, according to all the accounts of the Hessian fly he ought to have found *the pupa*; he therefore at once draws the important inference, that the German insect cannot be the Hessian fly of America. Indeed it is surprising, that so plain a fact as this, that it is a worm and not a pupa which is enveloped in the flax seed case of our insect, has been so wholly overlooked by every one who has hitherto written upon this subject.

THE PUPA. *When formed.*—On the access of the first warm days of spring, as soon as the weather becomes sufficiently genial for some of our earliest plants to put forth their blossoms, the larva of the Hessian fly is rapidly stimulated to maturity. The present year, so early as the 21st of April, most of the insects were found to have taken on their pupa form. As this season was more forward than usual, this may prove to be an earlier date than is common for this occurrence; a more accurate criterion by which to indicate it definitely, is no doubt by a reference to the progress which vegetation has made at this time. We may therefore state, that in all parts of our country, the Hessian fly will probably be found in its fully formed pupa state, about a week after the liverwort, (*Hepatica triloba*), the trailing arbutus (*Epigaea repens*), and the red or swamp maple (*Acer rubrum*), first appear in bloom, and simultaneously with the flowering of the dry strawberry (*Comaropsis fragarioides*), the common five-finger (*Potentilla canadensis*), the hill-side violet (*Viola ovata*), &c. It continues in this state about ten or twelve days, and then sends out the winged fly.

Its characters.—The flax seed shell has now become quite brittle, breaking asunder transversely if rudely handled, and one of its ends slipping off from the inclosed pupa like a thimble from the end of the finger. On removing the pupa (fig. 1) from its case, it is found to be 0.13 long by 0.05 broad, of an oval form, with rounded ends, and having its limbs and body enveloped in separate membranes. The thoracic portion is slightly narrower than the abdominal. The wings do not quite attain the middle

of the length of the body. The outer pair of feet come out from under the tips of the wings, and reach to the anterior margin of the penultimate abdominal segment, slightly curving inwards at their tips. The next pair of feet are somewhat shorter, and the inner pair are shorter still. They all lie in contact with each other, and in a direction nearly parallel with the body. The abdominal segments are distinctly marked by strongly impressed transverse lines, and are of a milk-white color, the thorax and head being of a delicate pale pink-red, and the feet translucent-white. On the anterior margin is a chestnut-brown crescentiform mark. It will hence be perceived, that in all the details of its form, the pupa of the Hessian fly coincides precisely with those of the other species of this genus which have been described.

Its change into a fly.—The time for its final transformation having arrived, the pupa breaks open and crawls from its puparium or flax seed case, and works its way upwards within the sheath of the leaf, until it arrives at some cleft in the now dead, brittle and elastic straw; through this cleft it gradually, by bending from side to side, crowds its body until all except the tip of the abdomen is protruded into the air, the elasticity of the straw causing it to close together upon the tip of the abdomen, so much as to hold the pupa in this situation, secure from falling to the ground; and as if to preserve the body in a horizontal position, the feet are slightly separated from the abdomen, and directed obliquely downwards, with their tips pressed against the side of the straw, thus curiously serving, like the brace to the arms of a sign post, to support the body from inclining downwards. Thus securely fixed, and now freely exposed to the drying influence of the atmosphere, the outer membrane of the pupa speedily exhales its moisture, and as it becomes dried, cracks apart upon the back part of the thorax; out of this cleft the inclosed fly protrudes its head and thorax more and more, as it gradually withdraws its several members, the antennæ, wings and legs, from the cases in which they are respectively enveloped—a process analagous to that of withdrawing the hand and its several fingers from a tight glove; until at length entirely freed, the now full-

fledged and perfectly formed fly leaves its pupa skin and mounts into the air.

Peculiarity in its metamorphoses.—It is sufficiently apparent from the account that has now been given, that the Hessian fly differs notably from all its congeners in one important point in its transformations. From all the observations that have been hitherto made, the cecidomyiids correspond with the other tipulids in this prominent particular—that their pupæ are naked. Other species, at least many of them, after completing their growth, cleave from their skins in the same manner that the Hessian fly does, but when the separation is formed, the inclosed worm invariably crawls from and forsakes its larva case. It is thus, even, contrary to what has been hitherto supposed, with the *C. tritici*. Since my essay upon that species was published, I have clearly ascertained that the mature or dormant larva does cast its skin. So far as I am aware, moreover, the cast skins in the several species are translucent, and of a membranous texture. In the Hessian fly, however, it becomes opaque, changes its color, and is of a firm or coriaceous texture. The inclosed worm, also, does not leave it, but remaining, eventually changes within it to a pupa, the same case thus forming its puparium. Its metamorphosis thus approximates it to the Muscidae or true flies, the Stratiomidae or soldier-flies, &c. and its pupa, in technical language is “coarctate” and not “incomplete” like the pupæ of the other cecidomyiids. Should usage therefore settle down upon the name *midge* as distinctive of the minute tipulids, there will still be a marked propriety in continuing to this species its old name, Hessian *fly*.*

*I doubt, however, whether the Hessian fly will continue to be the sole member of this genus having a coarctate pupa. Quite recently a species has occurred to my notice, analagous to the Hessian fly flax seed in every point that I have been able to detect, except that its larva case is of a pale brown color, untinged with rufous or castaneous. It infests the *Agrostis lateriflora*?, numbers dwelling together in an imbricated gall, somewhat resembling the fertile aments of the hop, though larger, and connected with the main stalk by a short pedicel which is inserted into one of the lowest joints of the culm. From the coriaceous texture of the larva case, I suspect the inclosed worm will not leave it, until transformed to a pupa and upon the point of evolving the perfect fly.

THE FLY. *Its Characters.*—In the female, (fig. 3,) the *head* is flattened globular, and black throughout. The *antennæ* (fig. e,) are about half as long as the body, and composed of sixteen joints, each of a cylindric-oval form, the length being about double the diameter; each joint is clothed with a number of hairs, of which those towards its base are slightly more robust and longer, about equalling the joint in their length, and surrounding it in a whirl. The joints are separated from each other by very short translucent filaments, having a diameter about a third as great as the joints themselves. The terminal joint is at least a third longer than the preceding ones. The two basal joints of each antenna are globular, and compact or not separated by an intervening filament, and exceed the following joints in diameter. The *palpi* (fig. f,) consists of three obvious joints, clothed with very short minute hairs. The two last joints are cylindrical, nearly equal in size, and about twice as long as broad: the basal joint is more short and thick. The *thorax* is oval, broadest immediately back of the wing-sockets, and black. The *scutel* is of the same color, projecting, and slightly polished, with the suture surrounding it sometimes fulvous. The *poisers* are dusky. The *abdomen* is elongate-ovate, its broadest part scarcely equalling the thorax in diameter; it is of a black color above, more or less widely marked at the sutures with tawny-fulvous, and furnished with numerous fine blackish hairs. The *ovipositor* is rose-red, and slightly exerted commonly in the dead specimen; it is susceptible of being protruded to a third of the length of the abdomen. The *wings* are slightly dusky, and fulvous at their insertion into the thorax. Their form and neuration is identical with that of the other species of this genus, except that the slight connecting nerve between the mediastinal and postcostal is commonly wanting, and the medial and forks of the anal nerves are extremely faint for a species of *Cecidomyia* so large as this. The legs are pallid-brown, the tarsi black, the femurs paler at their bases. The several pairs of legs equal each other in length, being about 0.24 long when extended, of which length the tarsus embraces one-half. The several joints of the tarsus are of the same relative length as in

other species; the short basal joint however, is much more indistinct than usual, insomuch that a minute examination of several specimens is required ere one is met with showing this joint distinctly.* This character, and also the neuration of the wings, clearly shows that this species belongs to the genus *Cecidomyia*, and not to Macquart's genus *Lestrimia*, nor Meigen's *Lasioptera*.

In the male, the *antennæ* (fig. d,) are three-fourths of the length of the body, with the joints of a short oval and nearly globular form, the diameter hardly equalling the length: each joint is surrounded with a verticil of longish hairs. The terminal joint does not differ from the preceding ones. The two basal joints are compacted together as in the female. The *antennæ* diminish very slightly in diameter towards their tips. The filaments separating the joints are smoky-translucent, nearly as long as the joints, and about one-third of their diameter. The *abdomen* (fig. 2,) is cylindric or slightly tapering towards its tip, and consists of seven joints beside the terminal one, which (viewed from beneath, vide fig. c,) consists of a transversely oval joint, giving off two robust processes, armed with incurved hooks at their tips; and between these processes at their base are two exceedingly minute papillæ. As ordinarily seen, in the living specimen, the abdomen is of a brownish-black color, more or less widely marked at the sutures with pallid fulvous or smoky whitish lines. In all other points the male coincides with the female in its characters.

Its duration.—That the fly which comes out in the spring continues but a very short time, I infer from the following data. A number of wheat plants, containing pupæ, were transplanted into a box of earth, April 21st, and inspected daily. On the morning of May 1st, about half of them were found to have sent out the perfect fly within the preceding twenty-four hours. On repairing to the field whence these plants were taken, the fly was found to be out in large numbers. At every step, a dozen or more would

* How well the engraver has executed his task will be obvious by passing a magnifier over the plate. The joints of the tarsi in fig. 3, and other minute details, scarcely, if at all perceptible to the naked eye, will then be distinctly recognised.

arise from their coverts, sluggishly fly a few feet, and alight again. In other fields, where none of the flax seeds could previously be found, an occasional fly was met with, on the same day. A week after this, on a thorough examination, no flies could be found, nor were but two specimens afterwards met with, until the coming out of the summer brood.

Second Generation.

After the full details that have already been given, but a few words will be required under this head. About the first of May the fly appears, and deposits its eggs upon the same crop of grain that has already reared one brood, and also upon any spring wheat that is sufficiently forward for its purposes. The radical leaves of the winter wheat are now more or less withered, and the fly therefore selects the more luxuriant leaves that have put forth above these. The worm hatches, and again makes its short journey to its future home, at the base of the sheath; it consequently now nestles at the first and second joints of the young stalk, and is sometimes, though rarely, as high as the third joint. Even before the worm reaches the base of the sheath, it has frequently grown nearly to its full size (as shown, fig. *m.*) The stalk has now attained such vigor and hardness that it is seldom destroyed by this spring attack. A slight swelling, immediately above the joint, (fig. B. §§,) commonly indicates the presence of the larva beneath. This is a fact which has been overlooked, or at least not distinctly stated by writers hitherto. We only find it noticed by Mr. Bergen, (*Cultivator*, viii., 133,) who informs us that in a crop of barley which was destroyed by the Hessian fly, many of the stalks were "at the joints as thick as a man's finger." The insect is therefore a true *gall-fly*, although when but one larva succeeds in reaching the joint, the swelling caused by it is but little if at all apparent. More commonly however, the straw becomes so weakened, that it is unable to sustain the weight of the wheat head, and it accordingly bends down (as represented, fig. B. ††,) with the force of the wind and rains. The appearance of a badly infested field, as harvest time approaches, cannot better be described than in the words of M. Köllar. The grain looks as

though a herd of cattle had passed through it, so broken and tangled together is the straw. The worm attains its growth and enters its flax seed state about the first of June, and the flies of this second generation commonly come forth about the last of July and in August.

Miss Morris's theory.—We do not deem it necessary to go into a detailed examination of the theory revived by Miss Morris in 1840, that the eggs of the Hessian fly are deposited in the grain, and that the larva lies in the centre of the culm. We suppose this theory to be abandoned by its late advocates, from the fact that for four years past, we have met with no farther attempts to sustain it. To us it appears manifest that the lady was widely misled at the very outset of her observations by an error in Mr. Say's account, to wit, that "the perfect fly appears early in June." Were this the case she might well enquire, "Where are the eggs placed? Surely not in the old and dying stalk . . . and there is no young wheat growing from June until September." The flies which Miss M. saw in June, 1836, "in countless numbers, hovering over and settling on the ears of wheat," we cannot but suspect were the same species which in this section of country appears in such swarms upon the heads of wheat about the middle of June, that it has been for years mistaken hereabouts for the wheat fly or midge. (Vide *Quarterly Jour. Agriculture*, vol. ii., p. 238 and 243.) In size and color it does closely resemble the Hessian fly, and might readily mislead any one just commencing their observations. That occasional specimens of the Hessian fly may be taken in June we do not doubt; but that the main brood comes out, deposits its eggs, and disappears, a month earlier than this, we are quite confident, from our own observations as already related, as well as from the testimony of almost every writer who speaks definitely upon this point. Those few larvæ which have been found in the centre of the wheat culm, were not unlikely of some other species, since in this particular its habits correspond with those of the *Cephus pygmaeus*, the *Chlorops pumilionis*, &c. That the Hessian fly larva resides in the sheath of the culm, and not in its centre, we feel confident Miss M. has herself become

convinced ere this day:—so earnest and candid an enquirer after truth, and one so capable of giving to every fact its due weight, cannot long remain in error, upon a point so susceptible of demonstration as this.

Its Parasites.

It is well known that one of the most effectual means for keeping the Hessian fly in check and preventing it from literally *swarming* all over our land, has been provided by nature herself. Other insects have been created, apparently for the very purpose of preying upon this, and thus preventing it from becoming inordinately multiplied. The world is indebted to Mr. Herrick for much interesting information respecting these insects, the result of his own accurate and patient investigations. As we purpose, should we succeed in more fully tracing out the history of these and other Cecidomyian parasites, making them the subject of a separate memoir at some future day, we refrain from devoting to them any considerable space in the present paper. The general reader, however, will scarcely pardon us, if we omit all allusion to them. We therefore subjoin a brief sketch of the contents of this part of Mr. Herrick's article.

The Hessian fly is preyed upon and devoured by at least four other insects. When its eggs are laid upon the wheat leaves, they are visited by an exceedingly minute four winged fly, (a species of *Platygaster*,) which punctures the egg and deposits in it four or six eggs of its own: the Hessian fly worm hatches, grows, and passes into its flax seed state with these internal foes feeding upon it: it now dies, and its destroyers in due time escape from the flax seed shell. Three other minute four winged flies, or bees as they would be called in common language, destroy the fly when in its flax seed state. The most common of these, by far, is Say's *Ceraphron destructor*. Alighting upon the wheat stalks, instinct informs them precisely where one of these flax seeds lies concealed. They thereupon "sting" through the sheath of stalk, and into the body of the worm, placing an egg therein, which hatching to a maggot, lives upon and devours the worm. Such are the means which nature has provided for preventing this pest from becoming

unduly multiplied. And so efficient and inveterate are these foes, that more than nine-tenths of all the Hessian fly larvæ that come into existence, are probably destroyed by them, Mr. Herrick thinks, and we have strong reasons for believing that his estimate is within the truth.

From the date given by Mr. Herrick of his first discovery of the egg parasite, we know that the first or autumnal generation is attached by it. Whether it preys upon the second or spring generation also, does not so clearly appear. From our own observations, and the well known habits of the other parasites, it would seem to be principally upon the second or spring generation which they prey. Indeed we can scarcely conceive it possible for them with their short ovipositors, to reach the flax seeds of the first generation, buried as these are beneath the surface of the earth and reposing at the roots of the young wheat. That these parasites are surprisingly abundant, and destroy immense numbers of the spring generation, any one can easily ascertain by collecting the infested straw at harvest time, and securely enclosing it, to preserve all the insects which hatch from it. He will thus obtain parasites in abundance, and only occasionally a Hessian fly. On the other hand, numbers of the young plants taken up by us in April, evolved nothing but Hessian flies. The observations of a single season, we are aware, cannot be relied on for establishing a point like this. But they force upon us the suspicion that it is chiefly the second generation that is infested by parasites, and that the first is comparatively free from them.

Remedies.

“An *effectual remedy*” against the Hessian fly, which has been so much enquired after and talked about, and by which term we suppose is meant some *specific* which will infallibly destroy or drive away the insect, or protect the crop from its ravages, never has been and probably never will be discovered. In truth, we regard the idea that a remedy of this character exists, as being equally absurd with a belief in the philosopher’s stone. There is probably no such thing as sure and infallible specifics against

any of the insects which invade our crops, any more than there is against those diseases which attack our persons. Still, believing this, we also believe that there is no noxious insect but what, when we closely study into its habits we can invariably discover some one or more ways of opposing it, by which we can with certainty to a great extent, if not entirely shield ourselves against its depredations. Thus is it with the insect under consideration. There is no remedy with which we can "doctor" it away—no charm with which we can say to it, "vanish, presto:" yet there are measures, which employed, will guaranty fair crops, when if not resorted to, no wheat will be gathered. Of this fact we are well convinced, both from personal observations, and the concurrent testimony of a cloud of witnesses.

A consideration of the various remedial measures which have been proposed, is therefore a subject of surpassing interest to every cultivator of the soil. We shall hence proceed to review them in detail, treating first of those, which, after a careful consideration of this topic, we regard as the most important.

1. *A rich soil.*—This is a safeguard which has been strongly urged by almost every one who has written upon this insect. Indeed an inspection of different fields of wheat in a district where this enemy is present, cannot fail to impress upon the observer the utility and importance of this requisite. Other things being equal, the crops on impoverished lands invariably suffer the most. Hence those on sandy soils, which retain the strength of fertilizing agents less than other soils, have in numerous instances been remarked as most severely devastated. A striking contrast, even, may very often be perceived in different parts of the same field. The summits of the knolls and ridges, situations where the soil is the most meagre, almost invariably show the greatest amount of damage; whilst the intervening hollows, to which the fertilizing matters are washed from the surrounding acclivities, sustain a comparatively slight if at all sensible injury. Yet the latter situations are the very ones which insects of this family are known to be most prone to frequent, being more low, shady, and damp. There can be no doubt, therefore, but the fly is as numerous in the hollows

of a grain field, as upon its ridges; and that it is only in consequence of the greater fertility of the former situations, that the crop there is enabled so effectually to withstand this enemy. Indeed, the farmers themselves, in districts where the fly has prevailed, have all learned from experience, that it is only upon fertile lands that it will do to sow their wheat. Hence Ezra L'Hommedieu long ago intimated that the Hessian fly on Long Island, by driving the farmers to manure their lands, instead of a curse had actually been a *blessing*. He says, "the land in Suffolk county and other parts of Long Island, was easily tilled, and by continual cropping with wheat was so reduced, that on an average not more than five or six bushels was raised to the acre. This mode of husbandry was still pursued, and although the land was gradually impoverished, the farmer found the crop, although small, more than would pay for his labor and expense. The Hessian fly put an end to this kind of husbandry, and in that respect has proved a blessing instead of a curse; no other way being found to prevent the injury done by this insect, but by highly manuring the land." (*Trans. N. Y. Soc. for Prom. Agric., &c.*, i., 57.) A writer in Delaware also states that the universal predilection there, was to have *large* rather than *rich* fields of wheat; that this insect was counteracting this, by compelling them to cultivate less land, in order to cultivate it well; and that its tendency consequently was, to make our population more dense, by making it the interest of every man to own no more land than what he could manure highly and till carefully. (*Carey's Museum*, xi., 301.) We thus have, even in the devastations committed by this destroyer evident indications of that

"All partial evil, universal good,"

which is every where manifest in the works of the Supreme Architect of nature. It is doubtless the additional strength and vigor enjoyed by plants growing upon a rich soil, which enables them to withstand the depredations of this insect. Those shoots which are first sent up from a kernel of seed, are the ones which are commonly attacked and destroyed, and in an impoverished soil

the seed itself thereupon perishes; whilst in a rich soil, its vitality continues, and other shoots are sent forth by it, which grow vigorously and unmolested. In the spring attack also, the weak and slender stalks growing upon a poor soil, are much more liable to become broken and fail of maturing any grain, than the large, robust, well nourished stalks of a fertile soil. Hence a rich soil enables a plant to elaborate a sufficient amount of fluids for its own sustenance, in addition to that which is abstracted from it by a few of these insects. We therefore regard this as a primary and indispensable measure and one which must accompany others next to be considered, in order to their full success.

2. *Late sowing*.—This measure also comes to us sanctioned by the almost unanimous recommendations of writers; and we regard it as one of the most efficient, as it certainly is the most facile of any that can be resorted to. It is universally admitted that it is the earliest sowed fields that are always the most infested; and we cannot but suspect that the present visit of this enemy to this section of the country, after so long an absence, has been invited by the general practice of early sowing, resorted to by our farmers under the probably incorrect idea of hereby escaping from the depredations of the wheat fly. Just before harvest, our attention was directed to two contiguous fields of wheat in the town of Stillwater, one of which was seriously injured by the Hessian fly, whilst in the other not a solitary straw broken by the insect could be found. The only cause to which this striking contrast could be imputed, was, that the latter field had been sowed a fortnight later than the former one. Analogous instances have often occurred to the notice of every observing person living in districts where the fly has been present. Such cases, however, must not be deemed to prove so much as they at first view appear to. It is not probable that the fly had entirely ceased from depositing its eggs before the second of the above fields had become forward enough for its purposes. Had the sowing of the first field been delayed a fortnight, both fields, it is probable, would have suffered equally. The whole injury that fell upon the first field, would thus have been divided between it and its neighbor. And so in

all cases, we presume that the field which is the earliest, attracts all of the insects in its immediate vicinity, and these finding all the accommodations they desire there, have no occasion for going elsewhere. For a more extended elucidation of this topic, see the *American Farmer*, vol. ii., p. 167. Two objections have been urged against late sowing; the liability of the young plants to "winter-kill," and of the crop when near maturity to be attacked by "the rust." There is little danger of the first of these casualties, we suppose, upon porous soils, it being a disaster almost peculiar to stiff clays, which retain a large amount of moisture at their surface. In such soils, therefore, it may be advisable to resort to the plan employed in some parts of England, namely, sowing only on a newly turned over sward, the grass roots in which serve to bind the soil together in such a manner as to retard its "heaving" by the frost. (*Fessenden's Complete Farmer*, p. 114.) This disaster, moreover, is guarded against in a great degree by sowing only upon a very fertile soil, whereby a quick and vigorous growth is secured, and the young plants are thus enabled to acquire sufficient strength of root to withstand the winter's frosts. The same expedient, also, by insuring a rapid growth and an early maturity of the crop is the best safeguard against the rust, a disaster to which late crops only are ordinarily liable. Upon rich land, therefore, scarcely any scruples need be entertained with regard to late sowing. If a neighboring field has been already sowed, and the season is favorable for its vegetation, it will be safe to commit the seed to the ground within a week or two thereafter, as all the insects in the vicinity, unless they are present in immense swarms, will be attracted to and remain in the earlier crop. About the last of September is probably as late as it will be judicious to defer sowing wheat in this climate; and in most seasons this will secure it from any serious attack of the fly. Although when it comes forward, the season for the deposition of the eggs of the fly may not in some years be entirely over, it must be rare that a number of these sufficiently large to be materially injurious, will be laid; but should that at any time be the case, other remedies still can thereupon be resorted to, to counteract the evil.

3. *Grazing*.—This measure is alluded to as worthy of attention, in the first account of this insect published in this country, where the fact is stated, that “by feeding the crop very close in the winter and spring, if the land is rich it will again spring up, and the worms do not much injure the second growth.” It is plain that a close fed crop will furnish few leaves for the fly to place its eggs upon, and these leaves will be commonly consumed before the eggs are hatched. Gen. Cocke directed public attention strongly to this measure in 1817, and six years subsequently states that full experience had amply confirmed him in his estimate of its efficacy. (*Amer. Farmer*, v., 241.) If in autumn it be omitted till after the eggs are hatched, and the worms have descended to the root, it can obviously be of little or no service. When, therefore, an attack of the fly is feared, as the exact time of the deposition of the eggs is somewhat variable in different seasons, it will be necessary to watch the young wheat, as soon as two or three blades from each root appear; and if the fly is discovered profusely depositing its eggs, sheep or other stock should at once be turned upon it, in such numbers, if possible, as to eat down the crop in a few days. The eggs will thus be destroyed, and the favorite nidus of the fly for continuing this deposite, will be effectually broken up: it will thus be compelled to resort to other quarters. The same process may also be repeated in the spring, if found necessary. No injury to the crop need be apprehended from its being thus grazed down, if the soil is of due fertility—it soon and entirely recovers from this operation. Moreover, if the soil is poor and impoverished, the fly will be sure to injure it far more than what the sheep will do. We cannot, theaefore, but regard this as a most judicious and important measure, if seasonably resorted to. The intelligent wool grower, will scarcely require to be informed, that sheep taken from their ordinary walks, should at first remain upon the rank feed of the wheat field but an hour or two of a day.

4. *The roller*.—Passing over the grain with a heavy roller, is a remedy in commendation of which several writers concur, supposing that many of the eggs upon the leaves will thus be crushed. Col. Morgan was in the habit of both rolling and grazing his

wheat fields, before the Hessian fly appeared in his vicinity; and as his crops were much less injured than those of his immediate neighbors, he attributes his escape to these causes. If there be any foundation for Mr. Smeltzer's opinion, that certain varieties of wheat are fly proof, because their leaves grow horizontally instead of inclining upwards, assuredly by a repeated use of the roller every kind of wheat may be made fly proof. No doubt this measure is a judicious one, particularly on fields that are so smooth and free from stones that almost every plant will receive a firm pressure by the operation. If resorted to, it should obviously be done at those times when the eggs are newly laid upon the leaves. After all, is not the efficacy of the roller, at least in part, owing to its loosening and dislodging the eggs from their position and causing them to drop to the ground, where the worm, hatching, is unable to find its way into the sheath of the young plant? This point merits investigation; for if there is any truth in the suggestion, sweeping the plants with a broom or some similar implement, will probably brush off much greater numbers of the eggs than passing a roller over them can do.

5. *Mowing*.—Mr. Goodhue, of Lancaster, Wisconsin, in a communication in the fifth volume of the *Prairie Farmer*, suggests that the larvæ concealed within the bases of the leaves, may be destroyed by mowing the wheat, and feeding it to the stock. We deem this proposal a valuable one for exterminating the second or spring brood from a wheat field. In those cases where the worms are discovered in the month of May, to be fearfully numerous at the joints of the young stalks, there can be little doubt but that on smooth grounds the scythe may be so used as to take off almost every spear below where the larvæ are lodged; and that thus a second growth of stalks will be produced, quite free from these depredators. The following facts incline me to believe that on a fertile soil, wheat may be thus mowed, with little if any eventual injury to the crop. Portions of a field of my own, the past season grew so rank, that deeming it would become lodged and mildewed, by way of experiment a space in it was mowed down after the plants were two feet in height, and another after

the heads had begun to put forth. Though not so early in ripening, the appearance of these two patches at harvest, indicated, so far as a single experiment could do, that wheat might be mowed at the former period without any diminution of its productiveness, whilst at the latter, both the straw and heads would be of a more slender and feeble growth.

6. *Fly proof wheats*.—That there are any kinds of wheat which are perfectly “fly proof,” (to use a common and expressive term,) as has been sometimes stated, we wholly disbelieve. At times when the fly is so excessively numerous as to attack barley and rye, it is not probable that any of the cultivated species of the genus *Triticum* can entirely withstand its attacks. But that there are kinds of this grain, that escape with little injury, when other kinds are almost wholly destroyed, is a well established fact. What the peculiar properties possessed by these varieties are, that render them thus singularly invulnerable, has never been investigated with that degree of accuracy which so interesting and important a subject well merits. Mr. Worth supposes that fly proof wheats must have smooth leaves, affording no grooved or channeled surface to hold the eggs of the fly. (*Amer. Far.*, ii., 181.) Mr. Smeltzer thinks the leaves of such wheat stand out horizontally from the stem, or incline downwards, instead of being erect, and that the egg is thus washed to the ground by rains. (*Patent Off. Report*, 1844, p. 434.) The Hon. J. Taliaferro regards the immunity as proceeding from the strength and vigor of the roots, whereby the plant continues to grow, notwithstanding the exhaustion of its juices by the worm. (*Patent Off. Report*, 1842, App. No. 1.) This theory appears to us more plausible and more in accordance with the facts recorded with regard to these varieties, than any other which has been proposed. Other opinions less specific, might be alluded to, but all of them are opinions merely, as we discover no evidence of their having been substantiated by a diligent investigation of this point. The reputation of the UNDERHILL WHEAT has already been sufficiently shown. This was a bearded white-chaff, with a plump yellow berry, requiring to be thoroughly dried before grinding, and then producing flour

in quantity and quality equal to the best of the other varieties. Its fly proof quality was by many supposed to be owing to the hardness or solidity of its straw. The fly freely deposited its eggs upon this wheat, but it was seldom, if ever, materially injured by it. The SPELTER WHEAT (*Triticum spelta*, Linn.,) was also long since remarked as never having been injured by the fly. This is so very inferior a species, that it is but little in use in this country, and only cultivated because it will grow well on the poorest soils, whether the season be wet or dry, and is free from all maladies. It has a long, slender, beardless head, with the chaff so firmly attached to the grain, that it can only be separated by passing through a mill, and yields a yellowish flour. It is more highly esteemed in Germany than in any other country, being there preferred even to all other kinds of wheat. The CHINA WHEAT, said originally to have been found in a crate of imported China ware, branches and grows very much like rye, ripens at least a week earlier than other varieties, yields largely, (forty or fifty bushels per acre it is said,) and has never been known to be injured by the fly. (*Pat. Off. Report*, 1844, p. 43.) The MEDITERRANEAN WHEAT, in such high repute for its fly proof and other qualities, was introduced into Maryland in 1837. It is a light red-chaff, having a long stiff beard, a long, red, and very flinty berry, and ripens about ten days earlier than other varieties. Mr. Garnett, in his Fredericksburg address, considers its only title to be designated as fly proof, is, that it recovers better than other wheats from the depredations of this insect. In the *South. Planter*, (vol. ii., p. 243,) it is said to be a coarse dark grain, much like rye, and yielding such indifferent flour, that some of the merchants had announced they would buy no more of it. Its straw too, when grown upon a fertile soil, is said to be too weak to support the head. Mr. R. L. Wright, in the *American Agriculturist* of 1843, and others, state that it improves by cultivation. As it becomes fully acclimated, it will, we doubt not, lose its most objectionable traits; but will it not with them also lose its fly proof and other qualities, which are its main recommendations at present? On the whole, this variety is so very prolific, and so ex-

empt from all diseases, that we are not surprised at the marked favor it has received. It is admirably adapted for securing a premium in our agricultural societies, where, "the largest crop, raised at the least expense" receives the prize; but its grower will be reluctant to inform his neighbors, that he sells it in market at six cents per bushel under the current price. In fine, we think this noted variety can never come into general favor in those districts where choicer kinds can be successfully cultivated. The *ETRURIAN WHEAT*, brought home by Com. Stewart, so far as yet appears, possesses all the most valuable qualities, and none of the defects of the Mediterranean. This is a bald variety, having a strong and vigorous stalk, a beautiful long smooth head, yielding a round, plump, white kernel, with a remarkably thin bran. It is very prolific, and quite as early as the Mediterranean, (Rev. D. Zollickoffer and others in the *American Farmer*,) and has thus far resisted the attack of the fly. We are gravely told by an anonymous writer, that "this wheat was not, as its name would indicate brought from the little Island of Etruria." In what creek this "little island" is situated, we have been unable to discover, but with such a decided negation, we are driven to the inference that the grain in question was derived from a territory which we *moderns* call Tuscany. The *WHITE FLINT WHEAT*, one of the choicest varieties of western New York, withstands the attack of the fly better than any of the other kinds there in use. For a full account of it, see Gen. Harmon's paper in the *Trans. N. Y. State Agric. Soc.*, 1843, p. 217. In conclusion of this branch of our subject, we would observe, that we should by no means be solicitous of procuring any variety of wheat, *merely* because of its fly proof qualities, believing as we do, that in all ordinary visitations of the fly, other measures are a sufficient safeguard. If vigor of root firmness of stalk, and rapidity of growth, are, as would appear, the points which render these varieties fly proof, a fertile soil will certainly go far towards imparting to most other varieties the same quality.

7. *Steeps for the seed*.—These have been recommended with a two-fold view. 1st. To destroy the eggs; decoction of elder, juice

of elder, boiling water, &c. These assume the erroneous position that the eggs of the fly are deposited upon the grain; it is manifest therefore that they can be of no utility. 2d. To insure a quick and vigorous growth of the young plant. Where sowing is deferred until late in the season, it may be judicious to resort to some measure of this kind to stimulate the seed to a more speedy and rapid germination and growth. In *Carey's Museum*, (vol. xii., p. 182,) an experiment of a Poughkeepsie farmer is related, who had soaked his seed wheat in a solution of saltpetre, four ounces being dissolved in water sufficient to wet a bushel. After soaking twenty-four hours, it was spread out and dried twelve hours, and then sowed, so late as the first of November. Early in the following June, this crop is reported as being in advance of neighboring ones which had been sowed early. This experiment, and others of a similar character, strikingly indicate that it lies much within the compass of human instrumentality to accelerate the growth of vegetation, by measures of this kind.

8. *Oats as a decoy*.—It has been recommended, to furnish a crop of young or of "volunteer" oats to the insect, on which to deposit its eggs; and when it has nearly or quite completed this operation, plowing the oats under, thus burying the eggs and larvæ, and then sowing the wheat upon their graves. To us, this appears only as "a tub to amuse the whale;" or, in other words, an admirable project for wheedling honest "Farmer John" into late sowing, upon an enriched, well pulverized soil. We have no clear evidence that the fly will deposite its eggs upon oats. It certainly will not be inclined to do so if there is any young wheat, barley, or rye in the vicinity to which it can resort.

9. *Wheat as a decoy*.—The preceding measure suggests to us another, which is well worthy of the attention of the agriculturist. The facts recorded respecting this insect, clearly show that it is the earliest sowed and most forward fields of grain that are most infested. The fly is attracted to these fields, and finding a more luxuriant vegetation, and a more shady covert here than elsewhere, and meeting with all the accommodations which it desires, it here remains, even though adjoining fields separated only by an open

fence, have come forward sufficiently to afford at least a part of the brood, quarters equally as comfortable. To us it appears evident, from these premises, that if one or two acres across the middle of a large field be sowed with wheat about the middle of August, all the flies in the vicinity will be attracted to this point, and there retained; so that it will be perfectly safe to sow the remainder of the field by the middle of September. If the Hessian fly is common in the neighborhood, the early sowed strip will be badly infested. If so, let it be turned under by the plow, either after two or three severe frosts have rendered it certain that the season for depositing the eggs is fully past, or early in the following spring—resowing it with winter wheat in the former case, or with spring wheat in the latter. By this procedure all the larvæ will be buried and perish. Only in one contingency, as we can perceive, will this plan be inexpedient or liable to fail, namely, when the flies are present in such vast numbers, that the decoy thus prepared is inadequate fully to accommodate them. Upon this point, the amount of damage done at the preceding harvest, will enable the cultivator to judge with a considerable degree of certainty. The advantages which this plan promises, are, that it draws all the insects of the neighborhood together, and destroys their entire progeny; it enables most of the grain to be sowed as early as is desirable; and finally, there will no second or spring generation come forth in the field to attack any part of the crop. This measure therefore, should receive a fair trial from some intelligent wheat grower in a district suffering under this pest.

10. *Deeply covering the seed.*—From the letters of A King William Farmer, and from the specimens furnished by him to Mr. Garnett, which are figured in the *American Farmer*, (vol. ii., p. 174,) the following facts would seem to be conclusively established, to wit;—That when a kernel of wheat is buried to the depth of about three inches, it sends a single stem upwards, which, within an inch of the surface forms a crown, sending from that point a tuft of fibrous roots downwards, and a tuft of blades upwards; these become the main roots and stalks, if undisturbed. But if these be destroyed by the fly, a new set of shoots and

roots start directly from the deep buried kernel, and these latter shoots are never attacked by the fly. A kernel but slightly covered, on the other hand, sends up its blades at once directly from the seed; if these be attacked therefore, the whole is destroyed. Such is a brief but plain statement, we believe, of the argument of the King William Farmer. In other words, seed slightly covered can send up but a single set of shoots, and being attacked by the fly, the whole perishes; but seed deeply buried can send up a double set of shoots; those first appearing are attacked and destroyed; those which thereupon start directly from the seed are never infested by the fly. Admitting the facts to be as set forth, it amounts to this, that by deeply covering, the same quantity of seed in reality produces two crops; one, which is speedily harvested by the fly; and the other, gathered at a later day by human hands. To this procedure we have two objections. By adopting it, you do nothing whatever towards destroying the insect or frustrating it in the least in its operations. On the contrary, you aim to provide food for it. You cherish it. You in effect say to it "be fruitful, multiply, and replenish the earth." True, by giving it what it wants, it leaves us as much more. But it is rather humiliating to us "lords of creation" to rear crops "at the halves" and place ourselves in the rank of mere tenants to so ignoble a landlord! Again, this measure only shields us against the autumnal attack. It does nothing against that of the following spring. Nay, by providing so well for the first generation, it tends to make the second generation more numerous, and the spring attack consequently more severe. Thus much upon the supposition that the facts are precisely as set forth by the King William Farmer. That he sincerely believed them to be correct, and that he was perfectly honest in the selection of the specimens which he forwarded to Mr. Garnett, we do not in the least doubt. Indeed the encomium which Mr. G. has written upon the character of his friend, must forever place him above all suspicions of insincerity or of any thing approaching to chicanery. But our own observations impress upon us strongly the conviction that he is in error in one most important point in his argument,

namely, that seed slightly covered, dies whenever its blades are destroyed by the fly. It is only in an impoverished soil that it thus dies; in a rich soil, as has been already stated, its vitality continues, its roots are so well surrounded with nutriment that they readily sustain it, and its first shoots being destroyed, it sends up a second set which grow unharmed. It thus performs the same operation which the King William Farmer contends, it can only do when deeply buried. Our specimen, from which the drawing (fig. A,) was taken, plainly shows this fact. The illustration is an exact copy from nature, of two shoots which were separated from a tuft of similar ones, all growing from one shallow covered seed; and in every infested field which we have examined, myriads of similar specimens might have been gathered, whilst commonly only on knolls and other barren or dry parts of the fields were the plants found to be wholly destroyed, as they were represented in the figures of the *American Farmer*. A fertile soil therefore insures the same results which are claimed for a deep covering of the seed. In both cases, the shoots which first appear are destroyed; another set appear afterwards, which are unharmed—not because the seed is buried too deep for the worms to crawl down to it, as the King William Farmer seems to infer, but because there are no flies any longer abroad to deposite their eggs upon the leaves. The exact truth then, with regard to this matter, we are firmly persuaded is as follows. In a meagre soil, the seed will die, whether it be covered slightly or deeply. In a less impoverished soil, *if the weather be dry* in September as it frequently is, seed near the surface will often perish, when that which is deeply buried will survive. In a fertile soil the seed will survive, whether it be covered shallow or deep. That suits of specimens can therefore be easily procured which will appear to demonstrate a state of things in every particular the very reverse of those figured in the *American Farmer*, scarcely admits of a doubt. Our conclusion then is, that the King William Farmer is measurably correct in his position, but by no means correct to the extent contended for. When the Hessian fly is present in any district, deeply covering the seed, especially if it be early sowed, will in

most cases be an additional safeguard against its destruction. The measure therefore is good as a subordinate one, but it must fall far short of ranking as a primary one.

11. *Procuring seed from uninfested districts.*—This measure also, is based upon the erroneous supposition that the eggs are deposited upon the grain. It can consequently be of no utility whatever as a safeguard against the Hessian fly. The measure has been fairly tested in several instances without success.

12. *Sun-drying the seed.*—Mr. W. H. Hill, in the *Nashville Agriculturist* of 1842, states that for fifteen years his wheat crops had not been injured by the Hessian fly, whilst those of his neighbors had suffered more or less. This immunity he attributes to two causes; exposing his seed to the sun for two days previous to sowing it, and sowing none but the largest and fullest grains, the others being separated by a sieve. Doubtless stronger roots and a more vigorous growth is obtained by sowing large, plump seed. We think that effectually drying the seed in the sun can have but one effect, that of retarding its germination a short time—an end that may be equally as well attained, and with less trouble by deferring the sowing until a somewhat later period.

13. *Drawing elder bushes over the young plants.*—We have here one of the fancies of a former day, it being supposed that elder possessed an odor or some more occult property, which rendered it peculiarly repulsive to insects. A trial of it against the Hessian fly, however, soon demonstrated that it possessed little or no virtue of that kind in reference to this insect. If any benefit ever resulted from it, it was probably only by dislodging and brushing off some of the eggs from the blades of the wheat.

14. *Sprinkling fine salt, ashes, or caustic lime over the young plants.*—The first of these measures was proposed, from its appearing at one time that wheat growing upon points of land exposed to the sea air was less injured than that growing back from the coast. Neither of these remedies however, have been attended with success, in any case on record, and they probably are of no service whatever, except as they may slightly increase the fertility of some fields. There is no likelihood that the fly, its eggs, or larvæ can be materially discommoded by them.

15. *Burning and plowing up the wheat stubble.*—This measure was originally proposed by judge Havens, and has been unanimously approved of and strongly urged by several of the most intelligent writers since. Indeed, a slight examination can scarcely fail of impressing upon every one its utility, independent of the sanction of authority. Whoever will at or soon after harvest inspect the stubble of a field that has been badly infested by the Hessian fly, will find these insects in their flax seed state lying one, two, three or more, at the joints of perhaps half the straws of the field. What a trifling labor, or rather what a pastime will it now be to set fire to this dry stubble and hereby inevitably consume countless thousands of these destroyers. This point appears so plainly evident, that no one we think will hesitate in pronouncing this remedy decidedly the most important and valuable of all. But a thought breaks in upon us, of such fearful import, that fancying we see the burning brand extended, in an instant more to send a sheet of vivid flame, leaping, hissing, and crackling over the fated field, we involuntarily shout

“Stop! or thy tread is on an empire’s dust!”

of a truth, what a short sighted mortal is man, and how often are the words of the poet verified, that “a little knowledge is a dangerous thing.” Seeing his enemy chained to the stake, he exultingly rushes at once to fire the faggots, and lo, a dozen of his friends are immolated upon the same pyre! Is it not a fact, that whilst by this measure we consume the Hessian fly by hundreds, we inevitably destroy its mortal foes by thousands? And that the very means which we thus resort to for averting a future calamity are the surest means that could be devised for bringing that calamity upon us! If nine tenths of every generation of the Hessian fly are destroyed by three or four other insects, who can calculate the value of the services which these latter are yearly rendering us. And who, then, will be so inconsiderate and ruthless as to destroy *nine* of these useful parasites, in order to exterminate *one* Hessian fly! Yet this must in most cases be the result of burning the stubble of the wheat field. We commenced our account of this remedy impressed with a belief that it was

the best that had ever been proposed; we close it, persuaded that it is the very worst.

Brief Summary of the preceding History.

The Hessian fly (*Cecidomyia destructor* of Say,) is a European insect, and has been detected in Germany, France, Switzerland and Italy, where it at times commits severe depredations upon the wheat crops. Its ravages are alluded to so far back as the year 1732. It was brought to this country, probably in some straw used in package by the Hessian soldiers, who landed on Staten and the west end of Long Island, August 1776, but did not become so multiplied as to severely injure the crops in that neighborhood, until 1779. From thence as a central point, it gradually extended over the country in all directions, advancing at the rate of from ten to twenty miles a year. Most of the wheat crops were wholly destroyed by it within a year or two of its first arrival at the given place, and its depredations commonly continued for several years, when they would nearly or quite cease; its parasitic insect enemies probable increasing to such an extent as to almost exterminate it. It is frequently reappearing in excessive numbers in one and another district of our country, and in addition to wheat, injures also barley and rye.

There are two generations of this insect annually. The eggs resemble minute reddish grains, and are laid in the creases of the upper surface of the leaf, when the wheat is but a few inches high, mostly in the month of September. These hatch in about a week, and the worm crawls down the sheaf of the leaf to its base, just below the surface of the ground, where it remains, subsisting upon the juices of the plant, without wounding it, but causing it to turn yellow and die. It is a small white maggot, and attains its growth in about six weeks. It then changes to a flax seed like body, within which the worm becomes a pupa the following spring, and from this the fly is evolved in ten or twelve days. The fly closely resembles a musquitoe in its appearance, but is a third smaller, and has no bill for sucking blood; it is black, the joints of its body being slightly marked with reddish. It appears early in May,

lays its eggs for another generation and soon perishes. The worms from these eggs nestle at the lower joints of the stalks, weakening them and causing them to bend and fall down from the weight of the head, so that towards harvest, an infested field looks as though cattle had passed through it.

Wheat can scarcely be grown except upon a fertile soil in those districts where this insect is abundant. The sowing should be deferred until about the last of September, the season then being past when the fly usually deposits its eggs. If at any time in autumn the eggs of the insect are observed to be profusely deposited upon the leaves, the crop should be speedily grazed down by sheep and other stock, or if this cannot be done, a heavy roller should be passed over it, that as many of the eggs as possible may be crushed or dislodged thereby. One or the other of the same measures should also be resorted to in the spring, if the same contingency occurs; or if the worms are at a later date discovered to be numerous at the first and second joints of the young stalks, the experiment may be tried of mowing as close down as possible, the most infested portion of the field. Where the soil is of but medium fertility, a resort to some of the hardier varieties of wheat, which are known to be in a measure fly proof, may be advisable.

Fitch's Point, Salem, N. Y., Nov., 1846.

Note.—Since our preceding essay, upon the *Cecidomyia tritici* was published, having had an opportunity of perusing the original articles of Mr. Kirby upon that species, we find that he both figures and describes the joints of its antennæ as “medio constrictio.” It is singular that this most important distinctive mark has been so misstated in the descriptions of that species which have been republished upon this side of the Atlantic, and also in Turton's edition of the *System of Nature*. From the remarks introductory to our “Description” some might perhaps infer that this error arose with the founder of the species. We hasten, therefore, to obviate any such impression.

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AN ESSAY

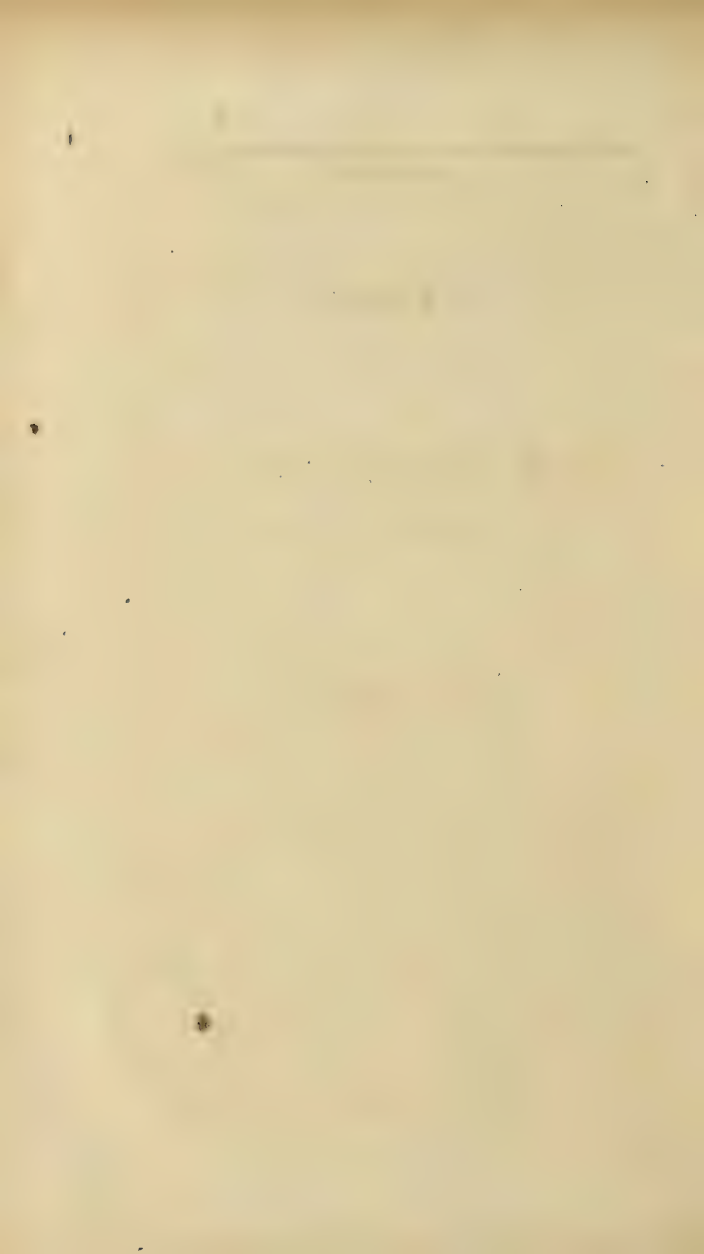
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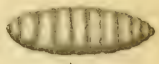
THE WHEAT-FLY,

AND SOME SPECIES ALLIED TO IT.

BY ASA FITCH, M. D.

ALBANY :
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1845.





DESCRIPTION OF THE PLATE.

WHEAT INSECTS, AND THEIR ANATOMY.

- Fig. 1. Clear-winged wheat-fly.
Fig. 2. Spotted-winged wheat-fly.
Fig. 3. *Cecidomyia tergata*.
Fig. 4. Male of the Clear-winged wheat-fly.
Fig. 5. *Cecidomyia thoracica*.
Fig. 6. Insect at rest, with its wings in their natural position.
Fig. a. Kernel of wheat, with its husks, and the worms feeding upon its pulp.
Fig. b. Pupa greatly magnified.
Fig. c. Wheat-head, with the chaff bent down by the yellow-bird, in getting at the worms leaving the grain, as at * * *.
Fig. e. Male antenna.
Fig. f. Ovipositor when drawn out, with three segments of the abdomen.
Fig. g. Leg of the insect, showing its joints, greatly magnified.
Fig. h. Female antenna magnified.
Fig. i. Insect in its natural size.

THE WHEAT-FLY.

ALTHOUGH several facts in the habits and economy of the wheat-fly had occurred to my notice at sundry times since its appearance in this vicinity, yet as my leisure for studies of this nature was wholly engrossed in other departments of the science of entomology, these facts had been observed in too cursory a manner to be of material value in preparing an account for the public eye. It has not been until the present year, that I have made this and its allied species my particular study. And as some few interesting points still remain undetermined, ere a perfectly complete history of this insect can be given, I should be inclined still to defer preparing a paper upon this subject, but that I deem some of the observations already made of too much importance to be longer withheld, and am moreover very well aware that if no writer ventured to appear before the public until his investigations were so complete in every particular that he could *exhaust* the subject on which he wrote, very little would be published, and the world would have but a small fraction of that amount of information which it now possesses.

It is necessary for me farther to premise, that although we have two distinct species of wheat-flies, as will be fully shown in the sequel of this paper, to wit, the *clear-winged wheat-fly* (*Cecidomyia tritici* of Kirby) and the *spotted-winged wheat-fly*, which has hitherto remained a nondescript; yet as nothing is yet known of the habits and transformations of one of these as distinct from the other, through the body of this article the common name "wheat-fly" will be employed for convenience as referring to both these species.

Future researches, however, may detect dissimilarities in their habits, and show that portions of the following account are true only with regard to one of these.

ITS FOREIGN HISTORY.

The first distinct and unequivocal account of the wheat-fly, of which I am aware, is that given by Mr. Christopher Gullet, in 1771, and published in the Philosophical Transactions of the Royal Society the following year.* From this it would appear that the effects

* So long ago as the year 1768, Col. Langdon Carter, of Virginia, transmitted to the American Philosophical Society a paper entitled "Observations concerning the FLY-WEEVIL that destroys the wheat;" which was published in the first volume of the Society's Transactions, 2d edition, pages 274 - 287. The account here given, is in nearly all its particulars so strikingly applicable to the wheat-fly, that so much of it as relates to the insect itself merits an introduction in this place. He rather quaintly remarks, "In a pleasant evening, after the sun was down, and every thing serenely calm, I found the rascals extremely busy amongst my ears, and really very numerous. I immediately inclosed some of them in a light loose handkerchief; and by the magnifiers of my telescope, I took occasion minutely to examine them. They are a pale brownish moth, with little trunks or bodies, some trifle shorter than their wings; and as some of their little bodies appeared bulging as if loaded, I applied the pressure of a fine straw upon them, and saw them squirt out, one after another, a number of little things which I took to be eggs, some more, some less: some emitted fifteen or twenty of them; and others appeared extremely lank in their little trunks, which I could not make discharge anything like an egg. Whether they had done this in the field before, or were of the male kind, I could not tell; but from this discovery I concluded that there need not be above two or three flies to an ear of corn, to lay eggs enough to destroy the greatest crop. * * * It is with much propriety called a weevil, as it destroys the wheat even in our granaries; though it is not of the kind termed by naturalists the *curculio*, of which they have given a very long list; for it is not like a bug; it carries no cases for its wings; neither has it any feelers, with which the *curculio* is always distinguished; and perhaps (as I fancy it will turn out in the course of this letter that they never attack grain when hard) they really have no occasion for such feelers. For from the make of it, to my judgment it appears an impossibility that it should ever perforate into a hard grain, being furnished with nothing in nature, from the most minute examination by glasses, that could make such a perforation; and seems indeed a fly itself, consisting of nothing sensible to the slightest touch with the finger, nor to the eye assisted with glasses, leaving only a little dry pale brown glossy dust on being squeezed."

I doubt not but that on perusing this extract, almost every reader who is conversant with our wheat-fly will feel confident that it is the same insect to which Col. Carter alludes. Yet if his account be more particularly observed, we gather from it some characters which assure us that it was not the wheat-fly which he examined. Although he uses the terms *moth* and *fly* as synonymous, and nowhere tells us whether his specimens had four or only two wings, yet he could scarcely have spoken of the lively orange color of our wheat-fly as "pale brownish;" and what is yet more conclusive,

produced by the wheat-fly had been known for some time to the farmers of England, though imputed by them to a wrong cause. He says, "What the farmers call the yellows in wheat, and which they consider as a kind of mildew, is, in fact, occasioned by a small yellow fly, with blue wings, about the size of a gnat. This blows in the ear of the corn, and produces a worm, almost invisible to the naked eye; but, being seen through a pocket microscope, it appears a large yellow maggot, of the color and gloss of amber, and is so prolific that I distinctly counted forty-one living yellow maggots in the husk of one single grain of wheat, a number sufficient to eat up and destroy the corn in a whole ear. One of these yellow flies laid at least eight or ten eggs, of an oblong shape, on my thumb, only while carrying by the wing across three or four ridges." (*Harris's Mass. Report*, p. 437.)

It was several years subsequent to this date, that the accounts of the appalling ravages of the hessian fly among the wheat crops of America reached Europe; and as this fly was universally believed to have been derived from the old world, extensive and careful examinations of the grain fields there were made, to detect it, that its habits might be learned, and means devised for preventing its becoming such a scourge as it was to this country. These investigations, conducted often at the public expense, and by men whose acquirements peculiarly fitted them for such a work, resulted in a confident announcement, which received general credence for a long series of years, that the hessian fly did not exist in Europe; yet in their course, several other species of insects injurious to the cultivated grains of that continent were discovered, and the wheat-fly received a particular examination. Mr. Curtis, generally so accurate in his statements, says that it was first discovered at this time; but

his insect, on being pressed between the fingers, left "a little dry pale brown glossy dust;" whereas the wheat-fly leaves no mark upon the fingers, unless it be actually crushed, in which case its fluid juices produce a yellow stain, without any glossiness. Every one accustomed to the handling of insects, will at once recognize the character in question as applying admirably to some small species of moth; and the "Committee on Husbandry" of the Society, in their remarks at the close of Col. Carter's paper, are doubtless correct in their statement, that these insects "appear to be of the same kind with those that do the like mischief in Europe, which a gentleman of Angumois describes to Mr. Duhamel," and which have since become so well known as the "Angumois grain-moth," described by the naturalist Olivier under the technical name of *Alucita cerealella*.

the account already given from Mr. Gullet, shows that it was known in England at least twenty-five years earlier than Mr. C. supposes, and anterior even to the date when the hessian fly was first observed in America.

In 1795, as we are informed by Mr. Marsham, in a paper read before the Linnæan Society, London, and published in their Transactions, vol. iii. p. 142, towards the end of July, Mr. Long had observed an insect that threatened to do much mischief to the wheat crops; attacking one or more of the grains in an ear, and causing the chaff of these grains to become yellow or ripe, whilst the remainder of the head was still green. Mr. Marsham, on opening the chaff of these grains, found an orange-colored powder, and in many of them, one or two very minute yellowish-white or deep yellow larvæ, the grain itself appearing to be a little shrunk. Mr. Markwich of Sussex also observed the same larvæ in his wheat, the forepart of August, but was confident they had done no injury to it. The same larvæ were also noticed by Mr. Kirby, this year, in Suffolk.

In a subsequent paper from Mr. Marsham (*Trans. Lin. Soc.* vol. iv. p. 224), we are informed that Mr. Markwich, July 12, 1797, saw the flies themselves, at rest upon the heads of the wheat, and also a few of the larvæ within the flowers; and that awhile later in the season the fly appeared reduced in numbers, whilst the larvæ had become much more abundant. From heads of the wheat enclosed in a flowerpot, he reared the fly, and also its parasite; the fly thus obtained having "spotted wings," a fact which we shall revert to hereafter.

Following this account is an excellent article (p. 230) by the Rev. William Kirby, who has since become so well known by his various writings upon entomology. Mr. Kirby here gives a scientific description of the wheat-fly, bestowing upon it the specific name *tritici*, by which it has been definitely distinguished by all subsequent writers, and correctly referring it to the genus *Tipula* of Linnæus, a genus which, in consequence of the vast number of species afterwards discovered to be comprised under it, naturalists have since found it necessary to subdivide; and the species in question at this day falls within that group to which the name *Cecidomyia* was given by Latreille, an arrangement concurred in by Mr. Kirby himself in his communication in Loudon's Magazine of Natural History, vol. i. p. 227; and which I note thus particularly, as by most writers in

our agricultural papers it is still spoken of as solely the *Tipula tritici* of Mr. Kirby.

In this article, and another presented about a year afterwards (*Trans. Lin. Soc.* vol. v. p. 96), Mr. Kirby gives a large number of most interesting and valuable observations upon this insect, the correctness of which, generally, more recent investigations have fully attested. With regard to its abundance at that time, he says he could scarcely pass through a wheatfield, in which some florets of every ear were not inhabited by the larvæ; and in a field of fifteen acres, which he carefully examined, he calculated that the havoc done by them would amount to five combs (twenty bushels).

From this time, we have met with no notices of the wheat-fly, except occasional references to the articles above mentioned, until the year 1828, when, and for a few of the following years, it again appeared in such numbers and with such havoc in several of the counties of England and Scotland, as to elicit communications in the magazines from several writers. In some districts of Scotland, its devastations would seem to have approached in severity what has been experienced upon this side of the Atlantic; for "Mr. Gorrie estimates the loss sustained by the farming interest in the Carse of Gowrie (the rich alluvial district along the Isla and its tributaries in Perth and Forfarshire) by the wheat-fly alone, at 20,000*l.* in 1827, at 30,000*l.* in 1828, and at 36,000*l.* in 1829" (*Encyc. of Agric.* 3d Lond. ed. p. 820. § 5066). And Mr. Bell, writing from Perthshire, June 24, 1830, says, "We are anxious to have the present cold weather continue for another ten days, to prevent the eggs from hatching, until the wheat be sufficiently hardened and beyond the state which affords nourishment to the maggot. Another year or two of the wheat-fly will make two thirds of the farmers here bankrupts" (*Gardener's Magazine*, vol. vi. p. 495). Mr. Gorrie, in a letter dated at Aunat Gardens, Errol, Perthshire, Sept. 1828 (*Loudon's Mag. of Nat. Hist.* vol. ii. p. 292), solicits information "on the nature and mode of propagation of a fly which has this year destroyed about one third of the late sown wheat all over this country." He describes a small yellow caterpillar, one eighth of an inch long, as numerous in the young ears of wheat, completely devouring the young milky grain, becoming torpid in about twelve days, and in six days more changing to a small black fly. In a subsequent communication, Aug. 1829 (p. 323), he corrects the latter part of the

above statement, and says, "At that time I did not know that a yellow fly had deposited the eggs within the glume, which became maggots. Observing numbers of black flies on the ears of wheat, I believed they had been the produce of the caterpillar. I have this season, however, observed the yellow fly (described by Rev. W. Kirby) deposit its eggs in the wheat-ear," etc. I notice this more particularly, because the farmers in this vicinity, with scarcely an exception, have fallen into the same error, and to this day suppose a small black fly, of the family *Muscidæ*, which occurs abundantly in wheat-fields, to be the real wheat-fly.

Mr. Patrick Shirreff, of East-Lothian, gives, in the same volume of Loudon's Magazine, pages 448 - 451, an excellent and very accurate summary of the habits and transformations of the same insect, the result chiefly of his own observations. For a concise account, this is not surpassed by any that has fallen under my notice.

Still more recently, this subject has been investigated by Prof. Henslow, from whom a communication appears in the Journal of the Royal Agricultural Society of England, vol. ii. p. 26; and in the same journal for the present year (vol. vi. p. 131. plate M.) an admirable production is inserted from the pen and graver of that accomplished naturalist, John Curtis, F.L.S., giving much more accurate and precise descriptions and delineations of the wheat-fly, in the different stages of its existence, than any that had previously appeared. To it I am particularly indebted for such characters as enable me to say without a doubt, that the clear-winged wheat-fly of America is identical with the English *Cecidomyia tritici*.

In closing this summary of the notices of the wheat-fly abroad, I would allude to what has occurred to me as perhaps true in the history of this insect, to wit, that it has somewhat *regular periods of recurring* in such numbers as to become a pest to the agriculturist. Thus, it would appear from Mr. Gullet's account, that it had been common for a few years previous to 1771. After an interval of twenty five years, it is again observed plentifully for three or four years, and in different districts, by Messrs. Kirby, Markwick and Long. Again it ceases to elicit attention, until a period but a little longer elapses, when, in 1828 and the following years, it forces itself once more and still more prominently into notice. All that I design, is, to direct attention to this point: the facts are as yet too few and too vague to justify anything more than a suggestion. The

observations of Mr. Kirby, reaching now over half a century, could probably shed some light upon this most interesting topic.

As respects the *extent of its range abroad*, it has been noticed in most of the southern and eastern counties of England, from Cornwall to Norfolk, and also in Shropshire; in Perthshire and the Lothians, and probably in other districts of Scotland; and in the north of Ireland. Whether it occurs upon the continent of Europe, we are not positively informed. It is not noticed by Macquart, either in his *Diptera of the North of France*, or his *Natural History of Dipterous Insects* (for a perusal of which I am indebted to the courtesy of Dr. T. W. Harris of Harvard University); and we can scarcely believe that if it existed in his district, it could have been overlooked by so assiduous a naturalist. M. Herpin, however (as we are told by Mr. Curtis), is of opinion that it is an inhabitant of France, and the statement which he makes strongly supports this opinion. He says, "I have also found in ears of corn, at the time of flowering, many little yellow larvæ, very lively, from two to three millimetres long, lodged between the chaff of the grain: these larvæ nibble and destroy the generative organs of the plant, and the germen where they are found are sterile. These larvæ appear to me to have a very great analogy with those which have been described in the Linnæan Transactions, under the name of *Tipula tritici*: it is probably a *Cecidomyia*." M. Herpin placed several ears of diseased barley and wheat in bottles, and in these bottles a number of cecidomyia flies were afterwards found. Meigen—a copy of whose noted work upon the *Diptera of Europe* I regret that I have been unable to meet with—as I learn from Mr. Curtis's paper, gives descriptions and figures of the wheat-fly. Were his specimens collected in Germany, or received from England?

ITS DOMESTIC HISTORY.

It will be unnecessary to particularly specify the various notices of this insect, that have appeared in the different agricultural papers of the Northern States during the last twelve years. The more important and valuable of these may be found in the several volumes of the *Cultivator* and of the *New-England Farmer*. An excellent summary of the history and habits of the wheat-fly, both in this country and abroad, is also given in Dr. Harris's *Report on the Insects of Massachusetts*, p. 437–444. Mr. Gaylord's paper on

injurious insects briefly notices this species (*Trans. N. Y. State Agric. Society*, 1843, vol. iii. p. 145 – 147.)

With the prominent facts that have been laid before the public by our agricultural periodicals, every intelligent farmer is already familiar. The great difficulty experienced by persons but little conversant with zoological science, in determining what this wheat-worm really was, forms a striking feature in the earlier notices that appeared respecting it. Thus, by some it was for a time regarded as an animalcule of the *vibrio* genus, analogous to the “eels” generated in vinegar and paste. By others, and quite extensively, it was pronounced to be a *weevil*, and this very improper name is to this day often applied to it. Others, still, deemed it to be “Monsieur Tonson come again,” considering it as a return of the *hessian-fly* to a section of the country from which it had long been absent. It would be easy to point out how erroneous each of these opinions are ; but I deem it wholly unnecessary, as the public mind is now no longer distracted upon this subject ; and the correct view, that this insect is a fly, peculiar in its habits, and differing from any of those previously known in this country, universally prevails.

It is not improbable but that one or both of the species of the wheat-fly may have been present in this country, in limited numbers, many years before it was distinctly noticed. In truth, common as this insect still is in this district, if our farmers, guided by the knowledge they have acquired of it, were not zealously searching for it in every field, I much doubt whether it would be at all observed here at the present day. And often too when a careful examination of the growing grain leads to a belief that the crop is scarcely infested, an inspection of the threshing-floor, or of the screenings of the fanning-mill, will frequently demonstrate that it was present in much greater abundance than was surmised. These facts plainly show, that this insect *might* lurk a long time in our country wholly unobserved.

Mr. Jewett says the wheat-fly first appeared in western Vermont in the year 1820 (*New-Eng. Farmer*, vol. xix. p. 301). It was not, however, till the years 1828 and 1829 that it became so numerous as to attract the attention of community ; the same years, be it observed, when its ravages were so annoying in Scotland. It was in the northern part of Vermont, bordering upon the line of Lower Canada, where it became so excessively multiplied at this

time ; and from that, as a central point, it seems to have extended in nearly all directions. In this vicinity, one hundred and twenty-five or fifty miles south of the locality above indicated, it was certainly observed in 1830 ; and in 1832 the wheat crops were so completely destroyed by it, as to lead to a general abandonment of the cultivation of this grain. Having spread east over Vermont and New-Hampshire, it in 1834 appeared in the State of Maine, and continued to advance in that direction, it is said, at the rate of twenty or thirty miles a year. Westward its progress would seem to have been less rapid, and along the Mohawk river by no means so generally destructive. It is not till within a year or two past, that it has appeared in the Black river country east of Lake Ontario, as I am informed by an intelligent gentleman resident there ; nor until the present season that it has been so injurious as to induce in some instances a premature mowing of the crop, and preserving it for hay. Rumor states that farther west, in the wheat-noted Genesee country, it has been detected for the first time the present year.

The history of its career, appears to be quite uniform in most of the districts hitherto visited by it. About two or three years after its first arrival at a particular locality, it becomes most excessively multiplied, and the devastations which it now commits are almost incredible. Though I believe that through unduly excited fears, or a hope of thereby destroying hosts of this marauder, a mowing of the crop whilst yet green, and a curing of it for hay, has often been resorted to, when, had it been harvested as usual, a less sacrifice would have been made ; yet many cases have occurred, in which diligent search by different persons has failed to discover a single kernel of grain in any of the heads of an entire field !

This havoc, so extreme and general, though not universal (for some fields even now escape with comparatively little injury), lasts but one or two years. The numbers of the pest, and its consequent ravages, soon become sensibly diminished ; and after the lapse of a few seasons, the cultivation of the wheat crop is again found to be comparatively safe, and its yield only in isolated instances materially lessened by the continued presence of the fly, which has now become probably a permanent inhabitant.

It is commonly supposed that this rapid diminution in the numbers of the wheat-fly has been produced by the general abandonment of the cultivation of wheat in this section of the country ; that

thus the insect, having no place to deposit its eggs where its young could be nourished, has become measurably "starved out." But that this opinion is erroneous, is I think evident from one or two facts. During this entire period, since notice was first attracted to the wheat-fly, there are some farmers who have every year continued the cultivation of wheat with very fair success, their crops having been in no one of these years so severely injured as to dishearten them ; and their respective situations are so dissimilar, that this immunity can with no plausibility be attributed to any peculiarity in the locations of their farms. Now if the swarms of these insects which for a time pervaded every neighborhood through this entire section of country, and which possess a power of wing capable of bearing them from twenty to fifty miles in a single season, had been in the "starving" condition supposed, how have the fields alluded to escaped destruction ? Certainly these myriads of tiny creatures could not have been reduced to such straits for want of the appropriate repository for their eggs, until after these crops had been utterly consumed. And, with the insect not exterminated, but still everywhere common, now that the culture of wheat has been gradually returned to with such success that it has again become general, why has not the fly again increased ? Why have the considerable crops of the past and the abundant ones of the present year in this (Washington) county, been so little injured ? I am firmly persuaded, therefore, that the speedy diminution in the numbers of the wheat-fly, which soon follows a season in which it has been extremely annoying, can not be truly assigned to the cause above stated ; but that it is rather to be attributed to that beautiful provision of nature, long since observed, and additional instances of the truth of which are brought to light by the investigations of every year, to wit, that an undue increase in any of the species of the animal or vegetable world never takes place, without being speedily succeeded by a corresponding increase of the natural enemies and destroyers of that species, whereby it again becomes reduced to its appropriate bounds.

Whenever once introduced, it is probable the wheat-fly will ever after continue in limited numbers, laying the wheat crop annually under a moderate contribution for its support. Isolated fields will occur where its devastations will be quite serious, whilst the crop of the district generally will suffer but little, and many fields none at

all. Such has appeared to be its history in this vicinity for several years past. Seasons favorable for its multiplication will doubtless occur, when its injuries will be much augmented ; as well as seasons of a reverse character, when its presence will scarcely be known. It is, therefore, very important that the entire history and habits of this insect should be accurately traced out. For only with a full knowledge of these, can we be able to resort intelligently to such measures as will keep its numbers constantly limited, or sweep it from those fields that will probably at times be excessively infested by it.

ITS HABITS.

Relying upon the correctness of the published statements, that it was not till "towards the last of June" that the fly infests the wheat-fields, and that "the principal deposite of eggs is made in the first half of July," I had not commenced searching for it, when on the 16th of June I was informed by a neighbor, that it had been present for some days in large numbers, in a field of thrifty winter wheat of his. Upon repairing to this field, a small black fly, about one third of the size and much resembling the common house-fly, was pointed out as the dreaded enemy ; and so universally has this doubtless harmless species been for years regarded as the true wheat fly by the farmers throughout this whole section of the "infected district," merely from the circumstance of its occurring abundantly in wheatfields simultaneously with the wheat-worm, that my companion was much surprised, and disposed to be incredulous of my assertion that *that* was not the wheat-fly. On opening the flowers of the wheat, however, the eggs of the real marauder were found in abundance ; and a sweeping, with the small gauze fly-net in common use by entomologists, between the stalks of grain towards their roots, immediately caught within it a number of the winged insects. My comrade was little less surprised on my pointing the real fly out to him, being scarcely able to conceive that such a tiny fragile atom, seemingly a mere moat floating before his eye, could be that potent enemy that had spread such desolation over our land. Several of the specimens thus caught, were of the spotted-winged species. These I conjectured, until I afterwards came to examine them attentively with the microscope, were only a variety of the

common or clear-winged species, else I should not have failed to have regarded them more particularly.

All parts of this field of four acres were found to be infested more or less with the wheat-fly, but they occurred most abundantly along one of its sides, in the field adjoining which, wheat had been grown the preceding year, which had been considerably injured by this insect. Such a host of destroyers as were here found, and the profusion of eggs that had been already deposited, strongly indicated that it must have commenced appearing in its winged state many days previous to this time.

The wheat-fly may be met with daily, from the fore part of June, until so late at least as the middle of August. Although it congregates in swarms about fields of wheat at the time they are in blossom, it also occurs in a great variety of other situations. It often enters houses, upon the windows of which it may be observed dancing along the panes of glass, sometimes in numbers. It may also be taken among the grass of pastures, and of alluvial meadows that have never been turned up by the plough. It is sometimes found in shady places, particularly along the margin of streams, associated with other minute species of *Tipulidæ* in those dances in which swarms of these insects so often engage. One specimen was met with on weeds, in the margin of an extensive and dense forest, through which it must have made its way, or over an adjoining lake a half mile broad, on the opposite side of which was the nearest cultivated ground.

The fly, during the sunshine of day, moves about but little, remaining mostly at rest, or lurking about in the shade furnished towards the roots of the growing grain. In the twilight of evening it becomes active, and continues so perhaps during the entire night; for before the morning sunrise it may be seen abundantly upon the wing, though less agile than in the evening, as though it had now become somewhat wearied, or was rendered sluggish by the coolness and dampness of the night air. Upon cloudy days, also, it resorts but little to its accustomed retreats. But it is during the evenings which succeed hot days of sunshine that it appears to be most busy and full of life. If a field infested with them be visited with a lantern at this time, such hosts as were little imagined to exist, will be found busily hovering about the grain, the most of them with wings and legs extended, dancing, as it were, slowly up and down along the

ears, intently engaged in selecting the most suitable spot where to deposit their eggs. This being found, the insect alights, and standing upon the outer glume or chaff of the kernel, curves its abdomen so as to bring the tip in contact at right angles with the surface of the glume. It now toils industriously to insinuate its ovipositor through the scale, which is not accomplished till after a considerable exertion. Sometimes even, the scale having probably acquired too much maturity and hardness to be pierced by the tiny stinger which the fly protrudes, it is foiled in its efforts, and, as if vexed at its ill success, spitefully jerks apart its wings and darts away. This occurrence, however, is rare. And having penetrated with its ovipositor into contact with the germ of the future grain, through this tube one egg after another is passed in at short intervals until several are deposited. The usual number of eggs thus deposited, appeared to be from six to ten; and as thrice or four times as many larvæ can sometimes be met with on a single germ, it is probable that three or four insects sometimes successively puncture the same floret. Very frequently two, four or six flies may be seen at the same time on different florets of the same ear, depositing their eggs; and Mr. Shirreff says, "Upon one occasion I numbered thirty-five flies on a single ear, and, after carrying it a distance of a quarter of a mile, six of them still continued to deposit eggs." This work being done, another laborious task for the tiny creature remains, that of withdrawing the ovipositor; and to accomplish this, the energies of the insect are sometimes inadequate, and it remains, Prometheus-like, chained to an immovable mountain, until it expires. This curious fact, first observed by Mr. Kirby, I have seen fully verified, meeting in several instances with the dead insect still remaining thus suspended.

Although the flowers of the wheat are the favorite resort of this insect for depositing its eggs, yet it is not limited solely to this plant. It is currently reported to have been occasionally met with in rye and oats in this country. Mr. Shirreff and Mr. Gorrie both found the wheat-worm in ears of the quack or couch grass (*Triticum repens*, Linn.; *Agropyron repens*, Pal. de Beauvois); and the latter gentleman hereupon rather naively remarks, "The fly has not known that modern botanists no longer ranged the couch grass among the wheat tribe; but, like myself, it is most attached to the Linnæan names and system." Mr. Markwick also found the same worms in the wild bearded oats (*Avena festuca*, Linn.).

The *eggs* are of an oblong, cylindrical form, with rounded ends. They are pellucid and nearly colorless at first, but acquire a yellowish tinge ere they are hatched, which is in rather over a week after they are deposited.

The *larva* has two distinct stages in its existence : an *active* or growing state, which is passed through in about a month ; and a *dormant* state, which then supervenes, and continues through the winter. This latter has been generally but incorrectly regarded as its pupa state by writers.

When it comes from the egg, the larva is a minute oblong soft worm, without feet or hairs, and transparent or of a whitish tinge at first, but soon changing to a bright amber or orange yellow. It moves but slowly, and with difficulty, by a wriggling motion of its body. It remains within the particular floret in which it is hatched, until it attains its full growth. Mr. Kirby says it feeds upon the pollen of the anthers ; and perhaps it does so at first, but certainly whilst they are yet quite small, all the worms within the floret cluster upon the sides of the germ, and generally towards its base (Plate 5, fig. *a*). I apprehend they chiefly subsist and attain their growth there, upon the fluids destined for the nourishment of the germ, and which, for want of these fluids, becomes shrivelled to a greater or less degree, and does not attain that plump form on which the value of this grain so much depends. The amount of injury received by the individual kernel of grain varies according to the number of worms that have been nourished in the chaff in contact with it. If mature worms grow from all the eggs deposited by the fly at a single puncture, the kernel is doubtless rendered worthless ; but a single worm, as is occasionally found, would scarcely produce a perceptible effect.

Having attained its growth, and in its dormant state, it does not differ sensibly, as I have been able to discover, from its previous appearance ; and the only reason for marking this as a distinct stage, is, that the insect now remains for a long period (probably two-thirds of its entire term of existence) without increasing in size or undergoing any other perceptible change. The texture of its body seems to have acquired rather more firmness than it possessed while it was growing, and its motions are more sluggish. It is less than the tenth of an inch long : a measurement of several specimens gives 0.07 as their average length. It is of a rich orange color, and

of an oblong-oval form (Plate 5, fig. *b*), being broadest in the middle and rounded at each end: it is slightly depressed, the under side being considerably flattened; thus in form considerably resembling the leech when contracted. Its joints are indicated by slight transverse impressed lines, by which it is divided into twelve segments of about equal length. Sometimes a brownish cloud is perceptible near the middle of the body on its under side, which is probably caused by alimentary matter. If these worms are placed for some days on a plate in a dry room, the outer skin of the body becomes so dry and indurated that the worm is incapable of making the slightest motion; but on covering them with a wetted cloth, the surface again in a short time becomes pliant and yielding; and if pressed with a needle, the animal writhes, and sometimes turns itself over to escape from the annoyance. I doubt whether it ever moults, or casts off its skin, between its egg and its pupa state; but my observations have not been sufficiently exact and prolonged, to speak positively upon this point.

This is the form in which the insect passes the autumn and winter. The accounts of writers disagree as to where the worm remains during this period; in fact few of them speak distinctly upon this particular point. Mr. Kirby, however, describes the worm as still continuing in the heads of the wheat; but as a considerable portion of them are missing, he thinks these have been destroyed by parasitic enemies. He says, "I have seen more than once, seven or eight florets in an ear inhabited by the (active) larvæ, and as many as thirty in a single floret, seldom less than eight or nine, and yet I have scarcely found more than one pupa (dormant larva) in an ear, and had to examine several to meet with that." Mr. Gorrie, on the other hand, asserts that the maggots quit the ears of the wheat by the first of August, and enter into the ground, where they remain through the winter. Mr. Shirreff, also, from finding the fly much more abundant in fields where wheat had been grown the preceding year than it was in other fields, entertains the same opinion. Now the truth is, Mr. Kirby and Mr. Gorrie are both right. A portion of the larvæ leave the grain before it is harvested, and descend to the ground, where I have found them, under mouldy fragments of straw on the surface, or buried a half inch or less within the soil. I thus found them, common in the field already spoken of as examined on the 16th of June, a few days after the grain was harvested; and

also early in March, in a field in which wheat was grown the preceding year, that had been somewhat injured by the fly. Another portion of these larvæ remain in the heads of the wheat, and are carried into the barn, where they may readily be observed upon the threshing-floor, and found in quantities among the screenings of the fanning-mill; a considerable portion of which sometimes consists of these worms. Thence our farmers *kindly* empty them out at the door of the barn, where most of them doubtless find among the litter of the yard a bed equally as comfortable and secure as that in which their brethren in the field are at this time reposing.

Whence does this singular diversity in the habits of these larvæ arise? Why do one part of them leave the wheat, and enter the ground ere the harvest; and another portion remain within the ears, to be carried into the barn when the grain is housed? for all the worms are undoubtedly fully matured before the grain becomes ripe and hard. Two well attested observations I think shed much light upon this subject; and if the inference that they have led me to be correct, this point will be regarded as one of the most interesting that occurs in the economy of this insect. Mr. Harris informs us, that "after a shower of rain, they (the larvæ) have been seen in such countless numbers *on the beards of the wheat*, as to give a *yellow color to the whole field*;" and he refers to the New-England Farmer, vol. xii. p. 60, in confirmation of this statement, a volume which I have not at hand. For an analogous but still more instructive fact, I am indebted to Gen. M'Naughton, a practical farmer of this town, the accuracy of whose statements no one acquainted with him will doubt. In 1832, his wheat, in which the fly had made sad havoc, was cradled and lying in the swath, when a moderate rain came on, followed by a damp cloudy afternoon. At this time, with his hired help, he repaired to the harvest-field to bind up the grain. They here found not only the heads, but also *the straw in its entire length sprinkled over with these worms*. On my observing to him, that I could scarcely believe it possible for a footless worm to crawl along the straw when it was lying horizontally, he stated that he was particularly positive with regard to that fact; for he distinctly recollected that it was impossible for him to draw the band around a bundle and tie it (in which process the heads of the grain are not touched), without having at least a half dozen of these worms adhering to his hands.

From these facts, I infer that the worm does not crawl out of the chaff and "drop" itself to the ground, as has been stated by some writers; but that having attained its growth, it lies dormant within the chaff, awaiting a favorable state of the weather in which to make its descent, to wit, a rain which is not immediately followed by a clear sky and warm sun that would soon dry the straw. Hence it is doubtless almost invariably by night that this journey of the worm is performed, and that it has therefore never been seen. The straw itself being wet, and the body of the worm rendered supple by the moisture surrounding it, it leaves its abode in the head of the wheat, and adhering to the wet straw by the glutinousness of the surface of its body, gradually works its way downwards by the wriggling motion to which it so often resorts when disturbed, until it reaches the ground. That there is such a glutinous secretion upon the surface of the worm as would enable it to adhere to the wet straw in the manner supposed, I might adduce a number of facts to prove. I was desirous of taking a drawing of the larvæ which I found among wheat-stubble last March; but particles of earth adhered to them so firmly, that I could not separate them with the point of a needle without also mutilating the worms. A few weeks since, on visiting a neighbor's threshing-floor, I gathered a number of larvæ by moistening the end of my finger and touching it to the worm, which, thus adhering, was scraped off upon the edge of a tin box. The box is now before me, with each of the worms alive, but firmly glued to its sides, and many of them to each other; and on forcibly removing some of them, the outer dried and hardened case of the worm is fractured in the operation.

It would thus appear, that those worms which are matured, leave the grain at the close of a shower, and crawl down the wet straw to the earth. It may be, also, that a heavy night-dew sometimes furnishes a sufficient degree of moisture to enable them to do this. But, on the other hand, those worms which are later in arriving at maturity, in awaiting suitable weather for making the same descent, are, ere such weather arrives, carried with the grain into the barn.

As illustrating the strong tenacity of life possessed by these larvæ, I may in this connexion state, that the few specimens gathered in March as already stated, were placed with a little earth in a vial, and a piece of gauze tied over its mouth, for the purpose of ascertaining the transformations of the insect, if any, from its then condi-

tion to that of a winged fly. Other avocations diverted my attention, and this vial was forgotten for a fortnight ; by which time the earth within had become so completely dried, that not doubting but the worms had all perished, no farther attention was paid to it, and it remained in a dry room over three months, until the middle of June, when, on examining it, half the specimens put into the vial were found to have completed their transformations ; a corresponding number of dead wheat-flies being found attached to a straw in the upper part of the vial. Prof. Henslow thinks that it is only those larvæ that are punctured by ichneumons, that leave the wheat-ears and enter the ground ; but the facts now stated, show that this opinion is erroneous.

On removing the earth from the vial above alluded to, the cases of the pupæ from which the flies had proceeded, were found very perfect. These conclusively showed that the real pupa is not formed until in the spring, and that it is then altogether different in form from what has been described by writers as its pupa.* It corresponds identically in its appearance (perhaps with the exception of color) with that of the *Cecidomyia salicis*, as exhibited in the first volume of this Journal, Plate 2, fig. 1. It also closely resembles the figure of the pupa of *Cecidomyia pini*? as given from De Geer in Westwood's Introduction to the Modern Classification of Insects, vol. ii. p. 518. fig. 125. no. 7.† Its length is slightly less than that of the dormant larva. The antennæ, legs and wings, are each enclosed in separate sheaths, which lay externally to the integument in which the body is enveloped. The three pairs of legs all lay parallel and in contact with each other upon the breast, reaching far down past the tips of the wings ; the inner pair being shortest, and the outer pair longest. Judging from the analogy afforded by the *Cecidomyia salicis*, I presume the wheat-fly only remains in its pupa state three or four weeks in the latter part of May and the fore part of June.

* Since making this discovery, I have strongly suspected that the pupa of the hessian fly has never been as yet detected ; and that its "flaxseed state," which has all along been regarded as its pupa, is only the same state which I have described as the dormant larvæ of the wheat-fly.

† I cannot but regard the figure here referred to as inaccurate, in representing the wings as enclosed in one common case, over which the legs are laid. The tips of the wings should probably be rounded, instead of being brought to a point.

ITS NATURAL ENEMIES.

One of the most effective natural destroyers of the wheat-fly, is undoubtedly our common yellow-bird (*Fringilla tristis*, Lin.) Fields much infested by the insect, have been for many years recognized even by passers on the highway contiguous to them, by the rough and ragged aspect of the heads of the grain (Plate 5, fig. c). I am not aware that the cause of this peculiar appearance has ever been stated in any of the communications that have appeared in our agricultural papers. It results from the operations of this bird. Alighting, it adroitly grasps the wheat-stalk just below the ear, and clinging fearlessly to it, even when swayed to and fro by the wind, it with its bill parts down the chaff from the grain, and one after another of the worms to which it thus gains access are rapidly picked off and devoured. Thus several heads are generally freed from the worms, ere its repast is completed. That it is the worms and not the grain that it is in pursuit of, is readily ascertained by an inspection of the heads after the bird has left them : many of the kernels, not being sufficiently loosened to drop to the ground by the operation, will be found remaining, the maggots that were upon them only having been removed ; whilst those kernels of the head which are not infested by the worm, are passed over untouched. It is curious that this little creature, by a tap with its horny bill, or some other process, is enabled to distinguish those scales of chaff which conceal so minute a worm, from those which do not ; a knowledge which we only arrive at when we have parted down the chaff. A flock, numbering about fifty, embracing both male and female birds, appeared to make the field which I examined on the 16th of June their constant resort, for a period of three weeks or more, where they could be seen busily occupied almost constantly every day. The number of worms consumed by them during this time must have been immense ; and I cannot but believe that this lovely bird will henceforward be esteemed for its utility, as much as it has heretofore been for its beauty.

I have as yet found but one insect parasite, which I am well assured subsists upon and destroys the worm of the wheat-fly. It is a hymenopter of the family *Chalcididæ* ; but my acquaintance with the details of its history is as yet too limited to attempt an account of it. I shall be much disappointed if I do not meet with still other

species which prey upon the wheat-fly; and as all these parasites upon the Cecidomyiæ are more or less closely related to each other, they can probably be most advantageously presented in a separate article devoted exclusively to that subject.

Four or more species are known abroad, which destroy the wheat-worm. One of these, it is stated in the first volume of the Edinburgh Quarterly Journal of Agriculture, deposits an egg beside an egg of the wheat-fly, the worm from which devours the wheat-worm soon after it hatches, and thus effectually saves the wheat. The observations of Mr. Shirreff upon another of these, cannot but interest the reader. He says, "Upon presenting four larvæ (of the wheat-fly) to an ichneumon, it soon stung, or, according to Mr. Kirby, deposited an egg in each of their bodies, and stung one of them a second time. The maggot writhed in seeming agony, and straggled upon my thumb-nail, where it was again stung three times by the same fly; and in a second struggle, both fell to the ground.

ARTIFICIAL MEANS FOR ARRESTING ITS RAVAGES.

These may be divided into two classes, as they refer to the protection of the grain from the fly when in its winged form and depositing its eggs; or as they are directed to the destruction of the fly itself, in the previous stages of its existence.

Several measures have been proposed, and some of them with much confidence and plausibility of reasoning, for protecting the wheat crop from this insect during the period of its blossoming. The more prominent of these I will advert to.

The smoke of a number of smouldering fires, or of brimstone matches, in different parts, and particularly upon the windward side of an infested field, has been recommended. The known efficacy of smoke in repelling the musketoe renders it probable that this remedy would be of signal utility, were it not for the discouraging amount of labor that is required to make so thorough and protracted a use of it as would be necessary.

It has been suggested that the anal follicles of the skunk (*Mephitis americana*, Desm.) might be extracted, and that yarn impregnated with the fluid contained in them, and suspended through wheat-fields, would, by its intolerable odor, banish the wheat-fly. I imagine that in carrying this suggestion into practice, the operator would be *the greatest sufferer* — "unless my nose deceives me."

Sowing the field with lime at the time the wheat is in blossom, has been repeatedly, and by some with much confidence, urged. This remedy has been much resorted to, and very conflicting statements with regard to its efficacy have been laid before the public. A simple experiment, directly to the point, is of more value than a thousand cases that *tend to support* any particular opinion ; and such an experiment I am prepared to narrate. Jarvis Martin, Esq., the owner of the infested field repeatedly alluded to, at my suggestion, repaired to it one evening, and sprinkled several of the heads with tolerably fresh air-slaked lime, until they were white with the powder adhering to them ; thus applying it far more profusely and effectually than can be accomplished by any "sowing" of this substance. With the light of a lantern, these heads were now closely watched, and the flies were observed to hover around and alight upon them as freely, and insert their ovipositors with the same readiness that they did upon the contiguous heads that were not thus treated. I deem this experiment sufficient to put to rest the much mooted question with regard to the utility of lime as a shield against the wheat-fly.

A yet more prominent, and much more plausible mode of enabling the wheat to escape injury from the fly, is, sowing the seed at such times as will prevent its being in blossom at the period when the insect appears. With this view, it is recommended to sow winter wheat much earlier than was ordinarily done, that it may be so far matured the following season at the time of the appearance of the fly, as to be invulnerable to it ; and spring wheat, so late as not to be in blossom until the fly has finished depositing its eggs. This plan has been much relied upon, on both sides of the Atlantic, and I have been heretofore disposed to regard it as probably the most feasible of any — though by avoiding Scylla we were in danger of Charybdis — for early sown winter wheat invites a return of the hessian-fly, and late sown spring wheat is almost certain in this vicinity to be attacked by "the rust" (*Puccinia graminis*). Numerous instances, moreover, can be adduced which tend much to support the utility of this measure. One of these, as strong as any that has come to my knowledge, I may here state. In a field of spring wheat of my own, raised in 1843, every kernel in the top of almost every head was entirely destroyed, whilst the lower two-thirds or three-fourths of the ears were wholly uninjured. I could

account for this only by supposing that these heads were just beginning to be protruded from their sheaths as the operations of the fly were closing for that year ; and hence confidently inferred that if that wheat had been sowed a few days later, it would have escaped entirely, or a few days earlier, it would have been entirely destroyed. By a reference to my Farm Book, I find this crop was sowed April 26th, and cradled August 10th, but no note was taken of the time when it was in blossom. I must confess, however, that my observations the present season have greatly diminished my confidence in the time of sowing as securing the crop from injury. Though I did not see the fly abroad until the 16th of June, it was then present in such swarms, and had already deposited its eggs so profusely, that I think it must have commenced appearing quite early in that month. It, moreover, continued to be abundant, until about the middle of July, and specimens were occasionally met with a month longer. Certainly if it is usual for it to be spread out over such an extent of time, it will be vain to rely upon the time of sowing, to insure a crop against its ravages. Some observations in the foreign accounts also throw light upon this subject. Mr. Shirreff says, in 1829 the fly appeared June 21st; "and from the vast numbers of them then seen, it is probable a few of them may have been in existence some days previous." Their eggs were seen June 23d, and must therefore have been deposited on the evening of the 22d. "The flies were observed depositing eggs on the 28th, and finally disappeared on the 30th of July, thus having existed through a period of thirty-nine days," and depositing eggs during thirty-seven of these days. I know not how Mr. S. could be certain that the fly had disappeared for the season on the 30th of July, for his account is dated the first day of August. For a few days only after their first appearance, he tells us, they frequented the couch-grass as well as the wheat. Was not this because there was not at that time a sufficient quantity of wheat in bloom to accommodate the number of insects that were then out ? And Mr. Markwick distinctly states that it was after the grain had been harvested, that he found the larvæ in the wild oats. Were not the parent flies then obliged to resort to this plant, because all the wheat had become mature ere they had completed depositing their eggs ? These facts certainly make it appear as though the fly is often abroad before the wheat commences blossoming, and continues till after it becomes mature.

Is there, then, no mode by which the flowering grain can be shielded from the ravages of the fly ? This is a subject on which I have bestowed much thought ; and I am not now prepared to tell the reader what *he must do*, but I will briefly inform him what *I shall do*, upon the first occasion that calls for it. A method is sometimes resorted to abroad, for saving grain fields from the depredations of certain insects of peculiar habits. A rope is drawn along over the grain, by two men walking at a brisk pace ; which rope thus knocking against the heads of the grain, causes the depredators to drop themselves instantly to the ground, and it is a slow and tedious task for them to get up to the heads of the grain again. A similar process, but with a different apparatus, I contemplate employing against the wheat-fly. This apparatus is a light net made of gauze, three or four feet deep and one or two rods long ; its mouth reaching the entire length of the net, and opening to a width of about eighteen inches. A small rope is to be stitched to the upper and another to the lower side of the mouth, reaching slightly beyond the net at each end, which is to be carried by two persons holding the ends of these ropes. If on closely examining the wheat-fields of my vicinity, from the time that the heads begin to protrude from their sheaths, the fly is found to be gathering in swarms in any one of them, I intend repairing to that field in the evening, when the insects will be hovering in such myriads about the heads of the grain, and, with an assistant, carrying the net so that the lower cord will strike a few inches below the heads of the grain, the upper one being held nearly a foot in advance of it, and about the same distance above the tops of the heads, by keeping the cords tense and walking at a uniformly rapid pace from side to side of the field, until the whole is swept over, I shall be much disappointed if *countless millions* are not gathered into the net, which is to be instantly closed whenever a pause is made, by bringing the cords together. It is now to be folded or rolled together into a smaller compass, and then pressed by the hands or otherwise so as to crush the vermin contained within it. This measure has been suggested to me, by observing the perfect facility with which the small entomological fly-net becomes *filled* with these flies, on sweeping it to and fro a few times among the heads of infested wheat in the evening. Of course this operation should be resorted to on the first appearance of the fly in numbers, and before its eggs have been

deposited so profusely as will occur in the course of a few days. I feel strongly confident, that by sweeping over a field a very few times in the manner above described, the fly may be so completely thinned out and destroyed, as to be incapable of injuring the crop perceptibly.

With regard to destroying the fly in the earlier stages of its existence, only a few words will require to be said. Whoever has read the preceding account of the habits of this insect, must have been struck with a consciousness of the perfect facility with which that portion of the worms that are brought into our barns may be exterminated. It would seem as though Divine Providence had expressly designed to place a part of every generation of these insects directly in the hands of man, that he might destroy them or not, at his option. And Uncle Toby is so extremely benevolent, that he has uniformly carried them to the door, and said "Go away, little flies, go away ; the world is wide enough for you and me both." Now it is scarcely necessary for me to say, that the screenings of the fanning-mill should invariably be closely examined, and if the minute yellow wheat-worms are numerous in them, the person should consider it a sacred duty which he owes to himself and his neighbors, to consign these screenings at once to the flames. If there are but occasional worms among them, let them be emptied into the hog-trough ; but never empty them upon the ground, or among the straw of the barn-yard, unless they appear to be entirely free from these vermin. And now, if that portion of the worms which remain in the fields can also be destroyed, it becomes certain that we are at once and forever relieved from all farther solicitude with regard to future injuries which this insect can inflict upon us. But can this be done ? It has been proposed to burn the stubble of wheat-fields after the harvest ; and if this measure be resorted to at a very dry time in the autumn, probably some of the worms would be destroyed by it. But, so far as I have observed, they uniformly lie here in situations where they are surrounded with some degree of moisture, under damp and mouldy clusters of straw and stubble, or slightly within the surface of the ground. It would, therefore, only be those straggling individuals that were not in their usual haunts, that the transient heat caused by such a burning would reach. Would a turning over of the field with the plow bury them to such a depth, that they would fail of finding their way to the surface again ? This

is an important inquiry. It is very probable that the larva can work its way to the surface, from a greater depth than what the pupa can. Direct experiment only can determine accurately at what depth the insect, in both these stages, must be buried in order to destroy it. No information of any value can, therefore, be given upon this point, until such experiments are made.

DESCRIPTION OF THE CLEAR-WINGED WHEAT-FLY.

The importance of full and accurate descriptions of every one of the several parts of a natural object, in order that it may be identified with certainty, is strikingly illustrated in the present species. For some years it has been *supposed* to be identical with the English wheat-fly; but those who are aware of the large number of both plants and animals in Europe, that have analogous representatives in this country so closely resembling them as to have been in many instances for a long time considered identical even by accurate and experienced observers, could not but entertain doubts upon this point; and with the fifteen or twenty characters of this insect which could be gathered from different sources, I could still only say that our wheat-fly was *probably* the *tritici* of Mr. Kirby, some of its prominent peculiarities seeming even to conflict with the descriptions given of that species. For instance, all that we could gather respecting the form of the joints of the antennæ, was, that they were "*moniliform*"; and Messrs. Kirby and Spence, in their "*Introduction to Entomology*," define this term to mean "oval or globular joints, like a necklace of beads." Now the joints of the antennæ in our insect are oblong, and each has a marked contraction in its middle, thus approaching to an hourglass shape, a form the very reverse of "oval" or "globular." It was not until I saw the excellent figures and descriptions of Mr. Curtis, that I became well assured that our species was identical with the European.

The common reader will get the most clear and definite idea of the appearance of the wheat-fly, by being told that it looks almost exactly like the wheat-worm with wings and legs added to it. These members, however, are so very small as to be scarcely recognized by the naked eye, except when they are fixed intently upon the object.

The HEAD of the *female* *Cecidomyia tritici* (Plate 5, fig. 1) is of an orbiculate or flattened-globular form, with the *eyes* forming its

periphery. These are large, occupying full two-thirds of the entire head. They are of a deep black color, and are separated from each other on the top of the head only by a slight and almost imperceptible cleft, so that when viewed in front they appear like a continuous broad black band surrounding the head, and interrupted only below at the mouth, thus resembling a horseshoe in their figure. The *face* is pale yellow. In its centre, and contiguous to each other, are two pale yellow tubercles or spherical eminences, more or less conspicuous, on which the antennæ are inserted, and which are by some regarded as forming a joint of these organs, in addition to the number commonly stated. The *antennæ* are of a deep brown or black color, less intense than the eyes. They are of about the same length as the body, and composed of twelve joints. Each joint (Plate 5, fig. *e*) is commonly oblong, with a marked contraction in its middle, a shape which is sometimes designated as 'coarctiform,' and is surrounded with a whirl or row of hairs near its base, and another near its apex.* The joints are ordinarily about thrice as long as they are broad, their diameter being but little less than that of the legs. They are connected together by a slender thread intervening between each joint, and about a fourth as long as the joints themselves. The two *palpi* are pale yellow, and clothed with shortish hairs : each is composed of four oval joints ; the terminal one being longer, but of the same diameter with the preceding.

The *THORAX* is of a pale yellow color ; its upper side commonly tinged with fulvous brown, which sometimes, though rarely, forms three vittæ or longitudinal spots forward of the middle. It is of an ovate form, its greatest breadth being immediately back of the wing sockets. Its vertical diameter much exceeds the transverse, as is common in most species of *Tipulidæ*, the breast jutting down far below the level of the head and abdomen. The *poisers* are oval,

* Not unfrequently, however, singular anomalies occur in these joints. Thus in some the contraction will be so considerable as to cause the segment to appear like two globular joints slightly but distinctly separated from each other ; whilst other segments of the same series are abbreviated and dilated, the usual contraction thus becoming obsolete, and the joint taking on a short cylindrical form. It would thus seem as though we, in the female, met with the twenty-four joints of the male antennæ in a modified or imperfectly developed condition ; that what appears as a single oblong coarctiform joint, is in reality two joints united. This would give but a single whirl of hairs to each joint, as is common in most of the species of this genus.

honey-yellow, their pedicels with a strong notch in the middle of their anterior sides.

The ABDOMEN throughout is of an orange color, more inclining to red than to yellow. Its broadest part scarcely equals the thorax in diameter. It is of an ovate form, attenuated towards its tip, whence the two valvular sheaths of the ovipositor are often seen more or less exerted, and sometimes the apex of the ovipositor itself projecting between them like a fine slender thread. According to Mr. Curtis, by a slight pressure on the abdomen of the living insect, the ovipositor (Plate 5, fig. *f*) can be made to protrude, and may then be drawn out to nearly thrice the length of the body.

The WINGS are hyaline and colorless, appearing like thin plates of glass or mica, but reflecting the tints of the rainbow, particularly the violet, when viewed in certain directions. Their margins are densely ciliated with longish hairs, and their surface is covered with minute pubescence. The mediastinal or *submarginal nerve* is but slightly distant from the costal (marginal), and becomes confluent with it rather forward of the middle of the exterior margin. From its middle, it sends a small connecting nerve backward to the postcostal. The *postcostal*, which is the most conspicuous nervure of the wing, runs direct, or with but an insensible curve, to the tip of the wing. The *medial* is straight, and attains the inner margin at about three-fourths of the distance from the base to the apex of the wing. The *anal* runs nearly parallel with the inner margin, and, with a very sudden curve from its direct course, joins the margin near its middle. It gives off an obscure branch at its angle, which curves outwards and backwards, joining the medial, or rather, seeming (if the wing be moved so as to give a slightly different incidence to the light) to be continued onward, parallel with and contiguous to the medial nerve, till it attains the margin of the wing. The medial and anal nerves are very slender, and are often invisible, except in a particular reflection of the light. The former, especially, can seldom be distinctly traced, except towards its termination. These details of the neururation of the wing apply equally well to all the species of *Cecidomyia* that have fallen under my observation, save only that they are more distinctly traced in the others, particularly the larger species. At rest (Plate 5, fig. 6), the wings are laid one upon the other, reposing horizontally upon the back of the abdomen, and reaching about a fourth of their length beyond it.

The LEGS are whitish or very pale yellow, long and slender, of a cylindrical form, and of nearly the same diameter through their entire length. The coxæ (small joints by which the femurs are connected with the sternum), as they are directed more or less backwards, vary the point from which the legs seem to arise in different specimens when viewed from above. The femurs, tibiæ, and second joint of the tarsi, are all of about the same length. The third, fourth, and fifth joints of the tarsi (Plate 5, fig. *g*), are successively shorter; whilst the basal joint is the shortest of all, its length little exceeding its diameter.

All parts of the body and limbs are clothed with minute, slender, longish hairs.

The MALE differs so remarkably in its aspect from the female, and is moreover so rare an insect, that it has generally escaped the researches of observers. It would appear from Mr. Curtis's paper, that Meigen is the only one who has identified and given a description of this sex; and I should distrust my having any specimens of it, but that one of the flies hatched from the larvæ already spoken of as gathered in a wheat-field early in the spring, is a male (Plate 5, fig. 4); and a few of my other specimens manifestly coincide with this. In these the *antennæ* are at least double the length of the body, and composed of twenty-four joints of a very exact globular form (Plate 5, fig. *e*); each joint encircled with a single row of hairs, and separated widely from its fellows, the thread between being of about twice the length of the joint itself. The *abdomen*, instead of being of an ovate form, as in the female, is broadest at the base, and thence tapers gradually, though slightly, towards the apex; the terminal segment, however, being broader than the one or two preceding it, and of a reniform shape, with the lobes directed backwards. The male is also somewhat smaller in size: in all its other marks, it appears to correspond with the female.

Among the hosts of specimens of the female that may be met with, there will occur considerable variations in size, color, and some minor particulars. The common length, to the tip of the abdomen, is the twelfth of an inch, or slightly under this; yet I have measured recent specimens from the wheat-field, that were but half this size. The color seems to be more uniform in specimens taken from the wheat-field, than in those procured in other situations. It is of a lively orange-red, particularly upon the abdomen, where the

color is most observed; but varies from that to amber or honey-yellow, lemon-yellow, and even to a cream-color. The specimens already spoken of as having been raised in dried earth, are all quite pale; and it would hence appear as though these lighter colored varieties were caused by unfavorable circumstances in which the insect had been placed when in its larva state.

THE SPOTTED-WINGED WHEAT-FLY.

Another species of *Cecidomyia* (Plate 5, fig. 2), as the reader has been already informed, is frequently met with, associated with the *tritici* in fields of wheat. It is closely allied to the *tritici* in form and coloring, having like it an orange-red body, hyaline wings, pale yellowish-white legs, and twelve joints to the antennæ, identical with those of the *tritici* in their details. It is, however, readily distinguished from the *tritici*, as well as from all the other species of this genus, with only two or three exceptions, by having spots upon its wings. These spots are so conspicuous as to be recognized by the naked eye, even when the insect is flying. They are of a pale black or smoky color, and seven in number on each wing. Two, and these the most conspicuous from being commonly of a deeper tint, are placed upon the outer margin: one being at the tip of the submarginal nerve, where it unites with the costal; the other, half way between this and the apex of the wing. Both these spots reach across the costal cell, and often slightly into the externo-medial. Another spot occupies the apex of the wing, at the tip of the post-costal nerve. Three others are based upon the inner margin, respectively at the apex of the medial and anal nervures, and at the axilla or base of the anal cell. The seventh spot is upon the disk of the wing, mostly in the outer middle cell, and is sometimes confluent more or less with one or more of the marginal spots. The nerves, when traversing these spots, are of a deeper black color than in other parts of their course, as are also the hairs which proceed from them into the fringed border of the wing. These spots are formed by a pigment in the membrane of the wing, the fine pubescence upon the surface being no more dense here than upon the other parts. The species under consideration is farther distinguished from the *tritici*, by invariably having the base of the abdomen, on its upper side, of a brown or blackish color. The thorax is often of a darker

fulvous brown ; and the breast is of the same color, instead of light yellow as in the *tritici*. The last joints of the feet, moreover, are commonly though not invariably black in this species, and there is often a broad black band at the base of the anterior tarsi.

The *males* have the antennæ composed of twenty-four joints, each encircled as usual with a row of hairs. These joints approach a globular form, but have, in common with those of the males of several other of our species, this striking peculiarity, namely, that through the whole series, though preserving the same diameter, they are alternately shorter and longer ; twelve being compressed-globular or double-convex, and between each of these a very short cylindrical joint with convex ends.

This species is closely related to the *ornata* of Say (*Appendix to Long's Expedition*, p. 357), but is readily distinguished from that by its blackish antennæ, the color of which contrasts strongly with that of the legs ; by the greater number of spots on its wings, and these spots not being "occasioned by the greater density of the hair of the surface in those parts." In the latter character it also differs from the *pictipennis* of Meigen, as described by Macquart ; as also in not having the spots forming bands across the wings. If any description of the *maculipennis* of Stephens, in his catalogue of British insects, has ever been published, I have not met with it. That this species, however, exists abroad, is highly probable, from the fact that the specimens reared from wheat-worms by Mr. Markwick had "spotted and transparent wings," as he describes them, or "obsolete clouds" as they were termed by Mr. Marsham. Mr. Curtis calls attention to this fact respecting these specimens, apparently from a suspicion thus excited that another species existed. He says, "I am particular in noticing this, because the wings of Mr. Kirby's *C. tritici* are not spotted, nor are any individuals that I have seen ; and excepting the *C. pictipennis*, which is larger, I know of no species of the genus with spotted wings."

The species under consideration, may appropriately be named and characterized as follows :

Cecidomyia caliptera. Orange-red ; base of the tergum blackish : wings hyaline, with seven dusky spots : legs whitish ; tarsi black at tips.

Length 0.05.

Var. α. Axillary spot of the wings wanting.*

β. Tips of tarsi whitish.

Specimens have been taken almost weekly, from the middle of June, till the fore part of September, in fields of flowering wheat, among the grass of plats contiguous to dwellings, and upon the windows of houses. I do not doubt but its habits are very similar and perhaps identical with those of the *tritici*, and that in proportion to its numbers it is equally destructive. The investigations of another year, may, I hope, enable me to furnish something more definite upon this most interesting subject.

SPECIES RESEMBLING THE WHEAT-FLIES.

We have what appear to be several species of cecidomyiides, allied to our wheat-flies in size, in the number and form of the joints of the antennæ, and more or less in the colors of their bodies. Among objects so exceedingly minute, and so closely related to each other, a most patient and critical study of a large collection of specimens, both in their recent and their dried state, is indispensable, in order to trace out with accuracy and define with precision each of these species. Perplexity and confusion will be the inevitable result of a hasty or superficial performance of a work of this character. It is hence that I shall at present venture to name and characterize but two of these species, whose marks are so evident and distinct as to render their recognition comparatively easy, yet whose colors are so analogous to those of the clear-winged wheat-fly that they would be confounded with it by ordinary observers, unless aware of their distinctive marks. I am only acquainted with these species in their perfect state.

A few specimens occurred to my notice about the middle of the month of August, having the abdomen more tinged with red than in

* On a careful re-examination of all my specimens while copying this paper for the press, and a reference to the dates and situations where each was collected, I discover that all those which have been gathered from wheat-fields are of this variety, having but six spots; and farther that the spot on the inner margin nearest to the base of the wing is situated in the middle of the anal cell, thus leaving the space about the apex of the anal nervure perfectly hyaline. Should the particulars here specified prove to be permanent and constant, as I believe they will, it must lead to a separation of this as a distinct species from the *caliptera*; in which event, the specific name *cerealis* might appropriately be bestowed upon the real wheat-fly having but six spots.

the wheat-flies, but commonly fading, when preserved, to a flesh-color or dull yellow ; the thorax brown or blackish above, its sides dull yellow ; legs blackish except at their bases, and poisers of the same hue ; wings dusky, with their nervures more distinctly marked than in the wheat-flies. I would propose for this species a name alluding to the contrast between the color of the thorax and of the abdomen, in a dorsal view of the insect (Plate 5, fig. 3).

Cecidomyia thoracica. Red : thorax above blackish-brown : legs and poisers blackish : wings dusky.

Length 0.05.

A much more abundant species, and very closely related to the preceding, occurs from the last of July till the middle of September, and perhaps later. Its legs are dusky, but not of so deep a tint as those of the *thoracica*, from which, moreover, it is readily distinguished by having invariably a fulvous-brown or blackish spot at the base of the abdomen on its upper side. The base and sides of the thorax are of the same color with the abdomen, namely, red, or in old specimens dull pale yellow ; the upper side, forward of the scutel, being brown. This species (Plate 5, fig. 5), may be named and characterized as follows :

Cecidomyia tergata. Red : thorax anteriorly and spot at base of tergum brown : wings, legs and poisers dusky.

Length about 0.06.

Both the preceding appear to be quite distinct from any of the European species that have been described.

In closing this paper, I have to apologize to the editors and patrons of the Journal for the delay which it has caused in the issue of the present number. I trust the paper itself may be found sufficiently acceptable to atone in some measure for this delay, its completion having required an amount of time far exceeding what I had anticipated.

NOTE. The insect, Plate 3, fig. 2, of the first volume, the name of which was omitted at that time, is the *Purpuricenus humeralis* of Fabricius.

SALEM, N. Y. October 8, 1845.

WINTER INSECTS OF EASTERN NEW YORK.

BY ASA FITCH, M. D.

It is the object of the following paper, to describe those insects of Eastern New York, which occur in their perfect state in the winter, and are peculiar to that season and the early part of spring. They are objects of curiosity, as coming forth to our view in full maturity and vigor, at that time in the year when almost every other member of the animal and vegetable kingdoms is reposing in torpidity under the chilling influence of solstitial cold. In an economical aspect, they possess but little importance, their period of life being limited to that season when the field furnishes no herbage, the garden no flowers, and the orchard no fruits, on which they can prey. They are chiefly interesting, therefore, merely as objects of scientific research—as forming integral parts of that vast array of animated beings, with which the Father of Life has populated our world, and rendered it vocal with his praise.

Hence it is to the scientific rather than the agricultural reader, that the following pages are addressed. To him they will be sufficiently intelligible, without such illustrations as have accompanied our previous contributions to this Journal.

A few words respecting the analogies of the two first species here described, may not be devoid of interest to the general reader. A small insect, destitute of wings, and bearing some resemblance to a flea in its general aspect, is found in the winter season, upon the snow in the northern part of Europe, and also occurs upon the Alps and the Hartz mountains. It has been known for nearly a century, and from its singularly anomalous characters, naturalists have been much perplexed to determine in which particular family of the insect tribes it might with the most propriety be placed. Linnæus was the first to classify and name it. He regarded it as possessing more analogies with the species associated in his genus *Parpano*, than with any other insects, and accordingly arranged

it with them, bestowing upon it the specific name *hyemalis*. But, inasmuch as it differed from the Panorpidæ in some prominent particulars, such as possessing the faculty of leaping, and being furnished with an ovipositor similar to many grasshoppers and crickets, Panzer, at a subsequent day, placed it under the genus *Gryllus*. More recent naturalists, however, have concurred in the propriety of the location originally given by Linnæus, and to obviate, in some degree, the incongruity of its situation, Latreille was induced to construct for it an independent genus, placed beside *Panorpa*, to which genus he gave the name *Boreus*. The *hyemalis* has remained to this day the sole species of this genus, no other insect having similar characters, having been discovered in any part of the world. Two years since, in the month of March, searching carefully upon the melting snow, to find if possible in this vicinity, a rare and singular insect which has been lately discovered in Canada—the *Chionea valga*, a fly destitute of wings—though unsuccessful, my labors were rewarded with an equally acceptable return, an insect cogeneric with the curious *Boreus hyemalis* of Europe. Since that time, I have met with numerous specimens, and have also found in the same situations, several individuals of a third species pertaining to the same genus. From these specimens I draw the following detailed characters of the

GENUS BOREUS, Latreille.

Polished and shining. *Head* sunk into the thorax to the eyes, which are prominent; ocelli wanting. *Rostrum* long-conical, twice or thrice as long as the head from which it gradually tapers, projecting downwards at right angles with the body, or more or less inclined backwards under the breast, its front side clothed with minute hairs. *Maxillary palpi* reaching beyond the tip of the beak; terminal joint longest and slightly thicker than the others, long ovate; basal joints cylindrical, half as long as they are broad. *Antennæ* inserted in the middle of the front, their bases nearer to the margin of the eyes than to each other, reaching half the length of the abdomen in the females and to its tip in the males, thickly set with very short minute hairs; filiform, hardly thicker towards their tips, composed of twenty-three joints; two basal joints thickest, the first sub-cylindric, the second obovate; succeeding joints short-cylindric, compact; terminal joint ovate. *Thorax* cylindrical, scarcely as broad as the head. *Wings*, in the males, rudimentary and not adapted for flying. Upper pair represented by two coriaceous pseud-elytral scales which reach rather more than half the length of the abdomen; these are broadest at their base and gradually taper to an acute point, the length being over four times as great as the breadth; they are very convex above and concave on their under sides, and thus when detached,

bear some resemblance to the chaff-scale or glume of a small kernel of grain; the apex is armed with a straight thorn-like spine which is directed backwards and downwards; the inner margin is studded with a row of small teeth, which are longer and more distinct towards the apex of the pseud-elytron; these teeth are inclined backwards, and at their points they are strongly curved in the same direction; both the outer and inner margins are minutely ciliated with short hairs. The under wings are represented on each side by a curved bristle which lies under the pseud-elytron and within its concavity; it scarcely exceeds the pseud-elytron in length, is slightly dilated at its base, curves inwards and downwards, is almost hooked at its tip, and gives off an occasional short hair. *In the female* the wings are entirely wanting, the only vestiges of them being two minute scales occupying the place of the upper pair: these scales are circular and scarcely the hundredth part of an inch in diameter in *B. nivoriundus*, slightly elongated and a third smaller in *B. brumalis*; they are convex above and concave beneath, and attached to the thorax by a short broad pedicel; their edges are ciliated with minute hairs; their upper surface is also thickly set with very short, erect hairs, and is crossed by an elevated rib or slight keel. *Legs* long, particularly the posterior pair, the length of which exceeds that of the body; their several joints cylindric and densely clothed with short minute hairs; the first tarsal joint half as long as the tibia, the four remaining joints successively shorter, terminated by two small, slender, simple hooks. *Abdomen* oval, depressed when exsiccated, the segments distinctly marked by strongly impressed transverse lines, and clothed with fine appressed hairs: in the males it is nearly cylindrical, but little broader than the head, truncated as it were at its apex and turned upwards; tip of the last segment furnished with two stout sharp-pointed hooks, each with an acute tooth in the middle of its inner edge, and pilose along its outer edge; these hooks are susceptible of being extended in a line with the body, but are commonly strongly recurved upon the back, shutting down upon and grasping a small scutel-like process which projects upwards at the base of this segment. They are thus recurved in coition, the male organ being exerted from between their bases. *Ovipositor* robust, about half as long as the abdomen of the female, projecting backwards in a line with the body, composed of a three-jointed semicylindrical piece above, and two ligulate valves below; the latter have their lower edges held in contact, thus forming a little gutter, and on the under-side towards their tips they are finely serrated; of the upper piece, the middle joint is much the longest, and is lined beneath on its concave side with a membrane which becomes distended with fluid when the abdomen is pressed upon; the short terminal joint is susceptible of being in-

clined obliquely downwards, thus, at least partial'y, closing the end of the ovipositor; the upper and lower pieces are widely separated in coition to enable the tip of the male abdomen to approximate that of the female.

1. *BOREUS NIVORIUNDUS.* *The Snow-born Boreus.*

Shining black or brownish-black; rudimentary wings, thorax above, with the rostrum and ovipositor excepting their tips, fulvous; legs dull fulvous.

Length, male twelve-hundredths of an inch; female, 0.15, or including the ovipositor 0.18.

Head black, highly polished, glabrous. *Eyes* black. *Rostrum* fulvous and feebly diaphanous, the mouth and palpi black. *Antennæ* black, two basal joints sometimes fulvous-brown. *Thorax* black on the sides, above varying in color from dull fulvous to cinnamon yellow, the basal half of the prothorax being black. *Abdomen* black, brownish black, or dull fulvous-brown; terminal segment fulvous or cinnamon-yellow, its hooks in the males cinnamon-yellow, their tips and teeth black and highly polished; ovipositor in the females diaphanous, fulvous, sometimes inclining to rufous, black at its tip. *Rudimentary wings* cinnamon-yellow, in the males often of a duller hue towards their tips; rudimentary inferior wings in the males of the same color as the superior. *Legs* lurid-yellow and sub-diaphanous, with a slender black annulus at each of their articulations; three last joints of the tarsi wholly black.

Closely allied to the *B. hyemalis*, which, however, appears from Rambur's Neuroptera, the Penny Cyclopædia, and the beautiful colored figure in Westwood's Introduction, the only definite authorities to which I am able to refer, to have the basal two-thirds of the antennæ of a russet color, and the rudimentary wings and the legs strongly inclining to red. Our species presents no tinge of rufous, except sometimes in the ovipositor; and the antennæ, black to their bases, is a decided distinctive mark.

This insect is by no means rare, being found upon the snow in forests in warm days, so early as December, and becoming more common as the season advances. I have met with it the most plentiful in April, when there has been a fall of snow in the night, succeeded by a warm forenoon of bright sunshine. Appearing so suddenly, in numbers, upon the clean, dazzling white surface thus spread over the earth, at the first thought it seems to be literally bred from the snow. I have not yet searched for it in the moss of tree-trunks, but doubt not that like the European insect, ours will also occur in this situation. When observed upon the snow, it is almost always stationary; and when approached by the hand, it commonly makes a leap, to the distance of a few inches only, its saltatory powers appearing but feeble.

2. *BOREUS BRUMALIS.* *The Mid-winter Boreus.*

Polished deep black-green; legs, antennæ, rostrum, and ovipositor black; rudimentary wings brownish-black.

Length, male 0.10; female 0.12, or including the ovipositor 0.15.

This species presents no very obvious characters beyond those already given. Its body is highly polished, shining even with a metallic lustre, whilst the eyes, antennæ, rostrum, and legs, reflect the light but feebly. The ovipositor is pure black, but equally splendid with the black-green abdomen. The scales which occupy the place of the wings in the females are but faintly perceptible, appearing like two minute greyish-black spots on the thorax. In the living insect, there is a light fulvous vitta, obvious to the naked eye, along each side of the abdomen, at the lateral suture; this is frequently obliterated or but imperfectly discernible in the dried specimen.

So far as I have at present observed, this appears abroad earlier in the season, and in colder weather than the preceding, though occasionally found associated with it on the last snows that fall in the spring. It is much less common than the other.

3. *PERLA NIVICOLA.* *The Small "Snow-fly."*

Black; wings grey, unclouded, a third shorter than the abdomen in the males, a third longer in the females.

Length 0.20, wings expand 0.45; males smaller.

Head shining, clothed with very short, fine hairs. *Palpi* brownish-black, sub-diaphanous. *Antennæ* reaching half the length of the wings, black, setaceous, about thirty-jointed; joints obconic, basal one largest. *Prothorax* flattened, its margins more smooth and shining, its disk rugulose, with a few shallow impressions; an impressed transverse line near the base and another near the apex. *Abdomen* shining, with a broad pale fulvous dorsal vitta which does not extend onto the two last segments; venter with a tint of obscure pallid at base. *Setæ* as long as the abdomen, black, setaceous, clothed with short whitish hairs; joints from thirteen to about eighteen in number, obconic, gradually shorter towards the base. *Legs* black, joints cylindric. *Tibiæ* obscure pale brown except at the tips, sub-diaphanous, grooved longitudinally. *Tarsi*, basal joint longest, second joint very short. *Wings* reaching half the length of the setæ, finely ciliated at their tips and along their inner margins; grey, diaphanous, immaculate; nervures black, robust, and very strongly marked, particularly on the upper pair which have five closed cells in the disk. The male is smaller, with the wings reaching but two thirds the length of the abdomen, its palpi and entire tergum black, and the tibiæ darker than in the female.

On warm days in the latter half of winter this species may be observed crawling with hurried steps upon the snow. It becomes most numerous about the time the snow finally disappears, and is then often seen on shrubs, fences, and buildings, and not unfrequently finds its way into our houses. It is extremely common, occurring most abundantly in the vicinity of streams of water, in which element the previous stages of its existence are passed. When first excluded from its pupa state, it is of a pale yellowish color, but gradually changes to black, this change commencing upon the thorax. Copulation occurs immediately after the female comes from the pupa state.

4. *NEMOURA NIVALIS*. *The Large "Snow-fly."* *The "Shad-fly."*

Black; wings griseous, faintly banded, double the length of the abdomen.

Length, males somewhat under, females over half an inch; wings expand about an inch.

Head covered with minute whitish hairs, which are longer and more obvious beneath the bases of the antennæ and around the mouth. Vertex with an obtusely impressed transverse line immediately back of the two posterior stemmata, and a longitudinal medial one, reaching from the former to the neck. Antennæ black, clothed with very short minute hairs, slender, setaceous, as long as to the tips of the wings in the males and somewhat shorter in the females, composed of about sixty joints; basal joint short-cylindrical, its diameter double that of the third and following joints; second joint intermediate between the first and third in diameter, its length and breadth about equal; the remaining joints obconic, gradually diminishing in diameter and increasing in length toward the tips. Palpi clothed with very short, minute hairs, black; basal joints of the maxillaries lurid and slightly diaphanous, penultimate joint rather the shortest and obconic, the joint preceding it longest and obconic, the terminal joint oval, and scarcely as thick as the others. *Prothorax* square, in the females scarcely broader than it is long, somewhat narrower anteriorly, posterior angles rounded, all the margins slightly and obtusely elevated, the posterior one more obviously so, often with a dull fulvous spot at the base, or with this color spread over the posterior part of the raised margin, and more rarely a similar spot at the middle of the apex; disk sometimes showing an impressed transverse line, and a longitudinal dorsal stria. Exposed portion of the *mesothorax* much elevated above the plane of the prothorax, forming a transverse ridge between the bases of the wings; clothed with short hairs; often with traces of dull fulvous around the wing-sockets; the portion of the mesothorax and metathorax covered by the wings smooth and shining. *Abdomen*

reaching but half the length of the wings; sutures of the tergum in the female more or less widely marked with dull rufous; tip, in the female only, furnished with two short, filiform setæ, scarcely equalling in length the segment to which they are attached; setæ pale lurid, sub-diaphanous, hairy, composed of about eight joints. Each segment of the venter with two transverse impressions, one situated towards each posterior angle. Male organ exerted, forming a conical lurid point near the base of the last ventral segment. *Femurs* cylindrical, black, clothed with white hairs, which are longer and more distinct in the females, inner side with a narrow deep groove which is dilated towards the apex. *Tibiae* cylindrical, about half the diameter of the femurs, grooved, lurid-brown, diaphanous, the ends and inner sides black; apex slightly incurved and armed with two short spines on the inside. *Tarsi* black, composed of three joints, whereof the middle one is slightly shorter; two claws and an intervening pellet at the tips. *Wings* griseous, when closed showing faintly two paler bands, one near the middle and the other back of it; edges ciliated with fine, short hairs. Upper wings diaphanous, grey, faintly marked with a darker cloud back of the middle, and another occupying the tips, but not reaching to the edge, these clouds becoming wholly obliterated in cabinet specimens; nervures black. Lower wings grey, sub-hyaline, nervures black.

When recently excluded from the pupa, the abdomen, except at its tip, is of a dull rufous color; this gradually becomes darker, and finally pure black. For a time after the venter has become wholly black the tergum continues dull rufous with a black band on each segment, which band does not reach the lateral margins. These bands increase in size, and at length the whole tergum is overspread with pure black.

It is not uncommon to meet with specimens of this and the preceding species, infested with a minute parasite of the family Acaridæ. These parasites are of a bright vermilion-red color, and fix themselves, one or more, at the sutures of the tergum, not quitting their hold after the death of the insect, unless disturbed.

This species begins to appear, soon after the Small Snow-fly is first met with. It occurs in the same situations, is nearly as abundant, and remains for a time after that has disappeared. One of the purposes served by these prolific insects in the economy of nature, doubtless is, to supply with food the fish of our streams, at this early period of the year. The larger of these species, continuing to be abundant when the the shad first come into our rivers, has evidently received one of its popular designations in allusion to this fact.

We regard this as the American analogue of the European *Nemoura nebulosa*, Linn. But, from several points in the extend-

ed description of that species given by M. Rambert, (*Suites a Buffon, Insectes Neuropteres*, Paris, 1842,) it is quite obvious that ours is a distinct insect.

5. CULEX HYEMALIS. *The Winter "Musketoe."*

Thorax cinereous, with a broad black vitta on each side; extreme tips of the wings and two spots on their anterior margins black, with two intervening sericeous yellowish-white spots.

Length 0.22; to the tips of the wings 0.28, or including the beak 0.39.

Head cinereous-pubescent, occiput black-pubescent. Proboscis black, its apex cinereous. Palpi black, the tips varied with gray. Antennæ black, tips brown. *Thorax* cinereous-pubescent, with a broad rufous-black vitta on each side, passing above the wing-sockets; the vitta often edged on its upper side with yellowish-white; a very slender, black, dorsal line, often partially obsolete. Scutellum glabrous, dark brown. Poisers black, their pedicels white. *Abdomen* clothed with longish gray hairs, black or dark brown, with two rows of whitish spots on each side; in the males obscure white, the posterior margins of the segments black. *Wings* subhyaline, with two blackish spots on the anterior margin, separated by a conspicuous glossy yellowish-white spot; inner spot with a strong notch on its posterior side which is formed by a yellowish-white dot, and a similar dot is placed on the inner side of this spot; outer spot with an oblique yellowish-white band on its outer side, beyond which, at the tip of the wing, is a slight blackish transverse spot. Under a magnifier, these spots are found to be produced by the colors of the scales upon the nerves of the wings, which scales are regularly and beautifully dyed with black and yellowish white, as follows: the posterior or anal nerve has black scales the last half of its entire length, and also at its base: the next or interno-medial nerve, which forks in its middle, is clothed throughout with black scales, including both its branches: the next or externo-medial has black scales on the basal fourth of its length, two broad annuli of black scales on its middle, another annulus at its fork, and a fifth series at the tips of each of its branches; the next is clothed with black scales through its entire length: the next is black where it first becomes plainly visible in the middle of the wing, again for a short distance after the origin of the preceding nerve, again for a considerable space at its fork, and again at the apex of its posterior branch only: the costal and the marginal nerves have black scales from their bases; these become much more dense at the black spots of the anterior margin, and are replaced by yellowish scales only between these spots and beyond the entire one. *Legs* black; femurs pale towards their bases; tips of femurs and of tibiæ whitish. Coxæ pale.

The Winter Musketoe is met with in the last days of autumn and again for a short time in the first days of spring, and specimens are occasionally found in any of the winter months. It is a somewhat rare insect, which no one can fail to distinguish clearly by the marks on its wings as above described.

6. CHIRONOMUS NIVORIUNDUS. *The Snow-born Midge.*

Black; poisers obscure-brown; wings pellucid-cinereous, their anterior nervures blackish.

Length about 0.15 to the tip of the abdomen in the males; females a third shorter.

This species is black throughout, and clothed with fine black hairs. The *thorax* has three slightly elevated longitudinal ridges immediately forward of the scutel. The *wings*, when the insect is at rest, are held against the sides of the abdomen, often vertically in the males, but more commonly in the females with their inner margins in contact, thus forming a steep roof covering the back. They are diaphanous, of a cinereous tinge, and feebly iridescent. Their inner margins towards their bases are slightly arcuated. The submarginal or postcostal nervures, those which bound the closed basillary cell, and which proceed from this cell to the margin, are particularly obvious, being of a blackish color, excepting the nerve which proceeds from the inner angle of this cell to the apex of the wing, which, with the nervures inside of it, scarcely differ in color from the surface which they ramify. The *poisers* are obscure-brownish, truncated at their apices, the capitulum being in the form of a reversed triangle. The *abdomen* in the females is shorter than the wings, somewhat compressed, approaching to an ovate form when viewed laterally, with the venter often of a dull brownish tinge: in the males it projects beyond the tips of the wings, is slender, cylindrical or very slightly tapered towards the tip, with some of the terminal segments separated by a strong contraction.

This is a very common species, appearing upon the snow in the winter season, and upon fences, windows, &c., in the fore part of spring, the males and the females being about equally numerous. The beautiful plumose antennæ of the former distinguish them at a glance from all other insects abroad at this season. At times they may be met with in immense swarms. April 27th 1846, in a forest, for the distance of a fourth of a mile, they occurred in such countless myriads as to prove no small annoyance to the passer, getting into his mouth, nostrils and ears at every step, and literally covering his clothing. These had probably hatched from the marshy border of an adjoining lake, on this and the preceding days, the weather having been remarkably warm and dry. The wings appear to be more hyaline and iridescent in those individu-

als that come forth earliest, but I am unable to detect any marks by which they may be characterized as specifically distinct from those which appear at a later day.

7. TRICHOCERA BRUMALIS. *The Mid-winter Trichocera.*

Brownish-black; wings and legs pallid at their bases; poisers blackish, their pedicels whitish.

Length of the male 0.18, of the female 0.25, the wings expanding twice these measurements.

Thorax with an obscure grayish reflection. *Abdomen* in the males cylindrical, slightly narrower towards the tip, in the females elongated-oval, and pointed at the tip; each segment with a strongly impressed transverse line in its middle, and the posterior margin elevated into a slight ridge. *Ovipositor* fulvous, sometimes tinged with blackish. *Wings* hyaline, faintly tinged with dusky; inner margins ciliated with quite short hairs; nervures blackish. *Legs* very long, slender, and fragile, blackish; femurs brown, gradually paler towards their bases.

Common in forests in the winter season, coming out in warm days, flying in the sunshine, and alighting upon the snow, its wings reposing horizontally upon its back when at rest. Even when the temperature is below the freezing point, and the cold so severe as to confine every other insect within its coverts, this may be met with abroad upon the wing. It is a plain, unadorned species, closely allied in its characters and habits to the European *T. hyemalis*, but in a number of impaled specimens before me, I can detect no stripes or bands upon the thorax; whilst the very obvious character of the legs and wings being pallid at their bases, I do not find mentioned as pertaining to that species.

8. PODURA NIVICOLA. "*The Snow-flea.*"

Black or blue-black; legs and tail dull brown.

Length 0.08.

Body black, covered with a glaucous blue-black powder but slightly adherent, and sparingly clothed with minute hairs; form cylindrical, somewhat broader towards the tail. *Antennæ* short and thick, longer than the head. *Legs* above blackish, beneath dull brown and much paler than the body. *Tail* of the same color with the venter, shortish, glabrous on its inner or anterior surface, with minute hairs on the opposite side; its fork brownish.

Though found in the same situations as the European *P. nivialis*, ours is a much darker colored species. Say's *P. bicolor* is a larger insect than the one under consideration, and differs also in size and in the color of the tail or spring. From the habits of the present species, we should infer that it might be abundant in all the snow clad regions of the northern parts of this continent; it

may therefore prove to be identical with the *P. humicola* of Otho Fabricius (*Fauna Gröenlandica*,) of which we are unable to refer to any but short and unsatisfactory descriptions, which do not coincide well with our insect.

This is an abundant species in our forests in the winter and fore part of spring. At any time in the winter, whenever a few days of mild weather occur, the surface of the snow, often, over whole acres of woodland, may be found sprinkled more or less thickly with these minute fleas, looking, at first sight, as though gunpowder had been there scattered. Hollows and holes in the snow, out of which the insects are unable to throw themselves readily, are often black with the multitudes which here become imprisoned. The fine meal-like powder with which their bodies are coated, enables them to float buoyantly upon the surface of water, without becoming wet. When the snow is melting so as to produce small rivulets coursing along the tracks of the lumberman's sleigh, these snow-fleas are often observed, floating passively in its current, in such numbers as to form continuous strings; whilst the eddies and still pools gather them in such myriads as to wholly hide the element beneath them.

